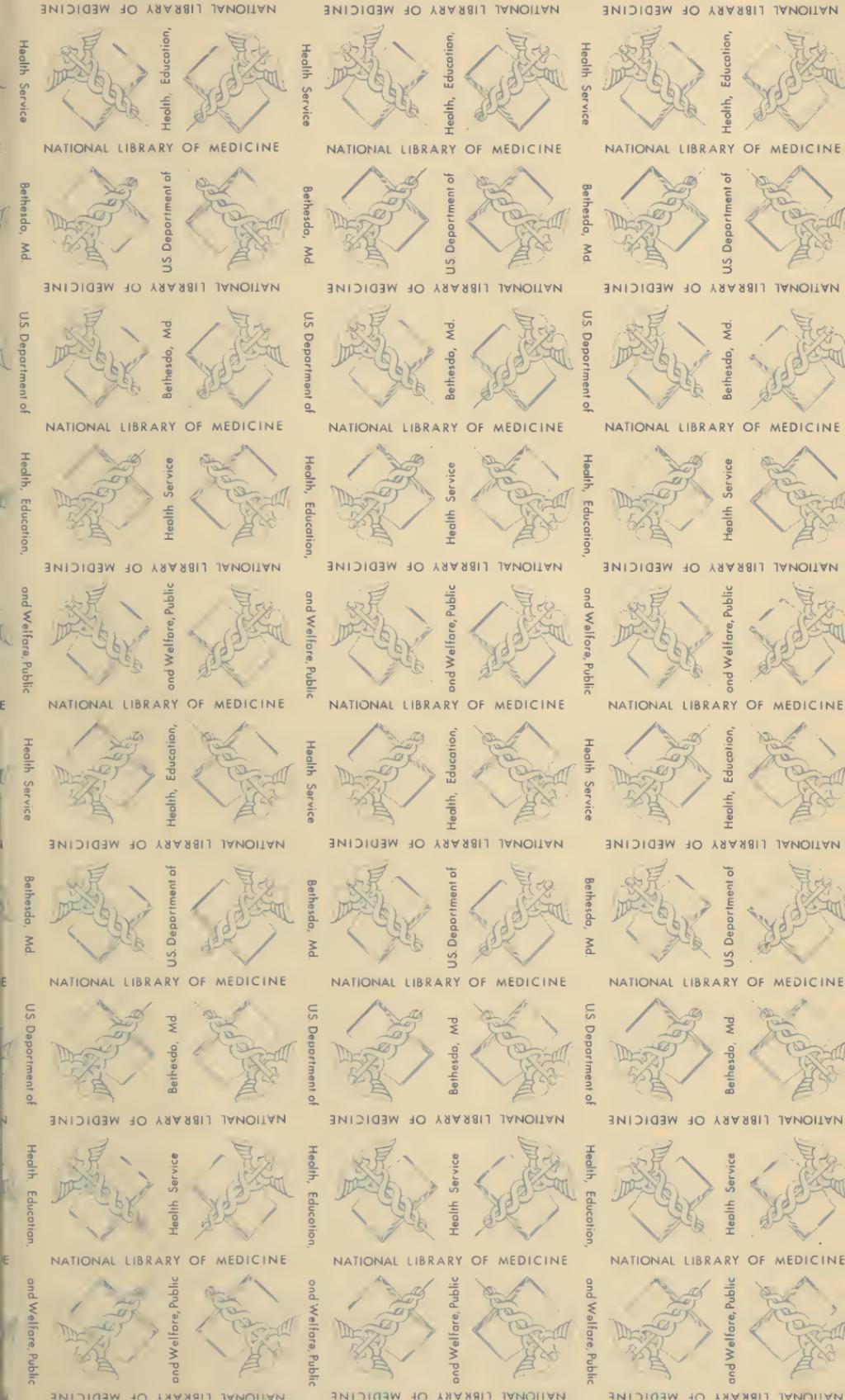


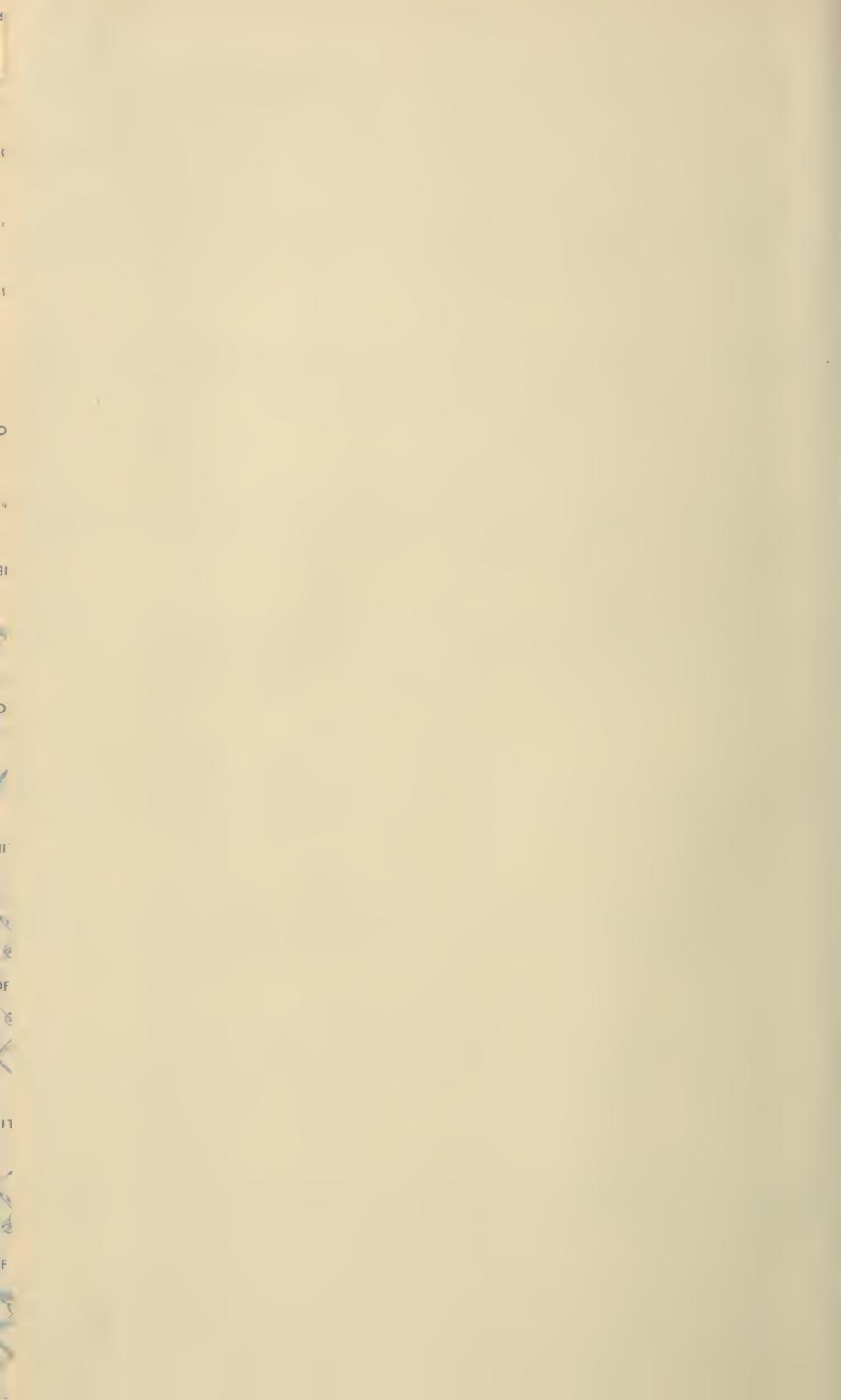
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Dedicated to
JOSEPH J. F. LE MAIRE
The First Regular American Dentist

Diagnosis *by* *Transillumination*

A treatise on the use of
transillumination in diagnosis
of infected conditions of the
dental process and various
air sinuses
with

a chapter on the
electric test for pulp vitality
by

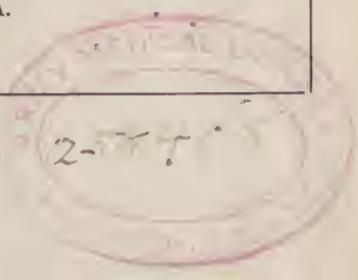
W. J. CAMERON, *Ph. G.*



Compiled from the results of
years of study, research and
clinical experience in collabora-
tion with leading physicians,
dentists and diagnosticians

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Preface

THE theory of diagnosis by transillumination is no longer considered to be hearsay or heresy by the thinkers in medicine and dentistry.

The universal approval accorded the first four editions of "Diagnosis by Transillumination" has prompted the preparation of a fifth edition, revised and amplified into a substantial text-book worthy of a place in the dentist's or physician's library and the college class room.

A logical presentation of convincing arguments sufficient to satisfy every open-minded analyst is given herein, and much care has been taken to emphasize the limitations, as well as advantages, of the methods considered.

Interested investigators will find many of the ideas presented in this book the result of original research. And, these methods are now being taught in many of the leading dental and medical schools.

The author has been most fortunate in receiving a large number of valuable suggestions from the profession, most of which are included in this edition.

Full credit is due Dr. Eugene S. Talbot; Dr. C. H. Davies of the Chicago College of Dental Surgery; Dr. O. Mayer; Prof. C. E. Tharaldsen of Northwestern University; Dr. Edwin J. Nestler of Columbia University; and other eminent men whose counsel was an important factor in the successful compilation of the work.

The methods outlined in this book have been generally accepted by leading physicians and dentists, and the clinical results obtained by the use of transillumination in actual practice are assuredly the best indication of its value.

W. J. CAMERON.

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PART ONE

Diagnosis by Transillumination



CHAPTER I

EFFECT OF DENTAL DIAGNOSIS ON MEDICAL AND DENTAL SCIENCE

SINCE the ancient Babylonians first treated toothache on the premise that caries was caused by small worms gnawing at the tooth, both medical and dental science have made notable progress, largely through the development of methods of diagnosis.

As long ago as the Egyptian Papyrus Ebers, we find a recipe for treating alveolar abscess, although most of the early practitioners of the dental profession confined their efforts to extraction. This prevalence of exodontia appears to have been the order of the day, on through medieval years well into recent times. With the full realization of the effect of dental infection on human welfare and the introduction of successive improvements in diagnostic procedure, the rapid advancement in dental practice has been noteworthy.

At the present time we find the medical practitioner according considerable importance to dental diagnosis, because of the relation of oral infection to certain ailments.

The clinical findings of both medical and dental science have conclusively shown that the teeth provide a fruitful field for the development of bacteria, which frequently have a pernicious effect on the general health.

Arthritis, pneumonia, rheumatism, myocarditis, pleurisy, nephritis, iritis, meningitis, pancreatitis, endocarditis, neuritis, periostitis, appendicitis, tuberculosis, gastric ulcers, deafness, insanity, and other disturbances have been traced to oral infection. As many authorities point out, distressing disease may develop from a primary focus within the mouth. The recognition of this fact has emphasized the necessity of correct dental diagnosis and made the introduction of improved methods a welcome addition to the armamentarium of medical and dental practitioners.

Radiography is being used extensively in the diagnosis of dental troubles. Where there is osteolysis, osteomyelitis, malformation of the bone structure, impactions, fracture of the



ST. APPOLONIA
Patron Saint of Dentistry, executed in early Christian Era. Illustration represents the Saint extracting a beggar's tooth. From an old manuscript.

dental process, etc., there is no doubt that an x-ray picture is valuable; but in the detection and location of recent infection (pathological change in the soft tissues), the radiograph has great limitations and, in fact, is of no value.

Dr. M. L. Rhein, in a recent paper, makes the following statement:

"We realize that the insidious granuloma may be present for some time without the x-ray disclosing any rarefied area."

In other words, radiography does not and cannot reveal congested areas in the periodontium in the earlier stages, and only indicates apical infection where there is a decided change in the alveolar structures.

Consideration of an ordinary abscess on the toe or finger gives a clearer understanding of dental conditions. After the initial infection we have the hyperemic stage, with redness, swelling, soreness, pain, throbbing and fever. Then, within 72 hours we have the congestion evidenced by discoloration, which remains until drainage is effected.

To a certain degree, conditions at the roots of infected teeth are similar. However, dental infections are not usually so acute as with an abscessed finger or toe, because of the limited supply of blood in the alveolar process and the difference in the nature of the infection.

Congestions due to root end infection, such as would be caused by putrescent pulps, etc., are evidenced by shadows during transillumination within 72 hours after inception. Though a gradual morbid change continues thereafter, it is frequently impossible to obtain definite radiographic evidence of these infections even after a lapse of from seven to ten years, depending on the variation in body resistance of different individuals.

Careful diagnosticians, of course, readily concede that there is a decided advantage in noting these conditions within 72 hours, rather than delaying until destruction of bony structure and surrounding tissue are evident on a radiograph.

Infected teeth *in situ* have been under daily observation with transillumination for many years, and at no time during this period were these areas evidenced by careful radiography. It is well to bear in mind that indications suggesting a focus of infection on a radiograph may appear so small that even an expert may not detect them on the film, and still the infection may be of the most virulent type. In laboratory tests, healthy rabbits inoculated with cultures taken from teeth extracted due to transillumination findings, despite the lack of radiographic evidence, have died within seven hours after injection.

No longer is it safe to assume that areas are dangerous simply because they are plainly evidenced by a radiograph, for dental authorities now assure us that these well circumscribed areas of infection frequently do not dissipate into the blood stream as freely as do those with which the

radiographic evidence is not pronounced. Therefore, it is well to consider a method of determination of these more elusive conditions.

Transillumination must not be considered to be of value only in locating infections of the soft tissue, for congestion frequently extends into the osseous structures and, when present, will be found by transillumination.

Years of observation have led to the belief that pulpless teeth are invariably infected and that a tooth with a non-vital pulp may become a predominating factor in the health of the patient at any time. That there is a slow progression of bacterial invasion is generally known. So it is evident that great care should be taken in controlling cases presenting such conditions.

CHAPTER II

A NEW ERA IN DENTAL DIAGNOSTIC METHODS

Several years ago the author became interested in the possibility of diagnosing dental infections by transillumination, believing the simplicity and practicability of the method would prove of unusual value to both the medical and dental professions.

The use of transillumination in diagnoses of the frontal and maxillary sinuses has been advocated in medical and dental colleges for many years. This procedure, however, until recently was never accepted as wholly dependable, due to the inefficiency of the lamps and equipment used, and because of lack of full understanding of the correct technique. This book outlines the proper methods for sinus and alveolar transillumination.

Heretofore, there were no diagnostic lamps that would produce sufficiently intense and concentrated equi-chromatic white rays to enable the operator to distinguish by shadows the difference between congested and healthy tissue, nor was any consideration given to the curvature necessary to project light at right angles directly through the dental process for the purpose of instantly locating abscessed or infected teeth.

What at first seemed an insuperable obstacle was finally overcome by the accidental direction of my attention to a searchlight. Searchlights are being constructed for commercial purposes which visibly project light a distance of five to eight miles by means of a powerful lamp, reflector and lens concentrating the rays so that the light is projected in one beam parallel to the axis.



A PHœNICIAN DENTIST

Illustration from *bas-relief* on a piece of antique pottery. The fingers seem to have been the principal armamentarium of the Phœnician Exodontist.

The searchlight principle was, therefore, taken into consideration, and after a great deal of laboratory work, this principle was applied in the development of a diagnostic lamp that made diagnosis by transillumination a reality.

This lamp, known commercially as Cameron's Dentalamp, has been accorded the status of an epochal development in medical and dental practice. The method, "Diagnosis by Transillumination," which makes the use of the lamp practical and possible, has been conceded the proud place of the greatest single aid in the accurate determination of infections of the dental process and various air sinuses.

CHAPTER III

TECHNICAL DESCRIPTION OF DIAGNOSIS BY TRANSILLUMINATION

The basis for the theory of diagnosis by transillumination is, that throughout the varying stages of pathologic evolution from the healthy dental process to the well defined abscess, there are many variations which cannot take place without a change in the blood content.

When the lens of the Right-Angle Dentalamp is placed directly against the tissue and moved slowly over the area being examined, the equichromatic white searchlight rays clearly transilluminate all the healthy alveolar process. A normal condition is indicated by a clear pink translucency.

Non-translucent areas (commonly called shadows, discolorations or opaque areas) always indicate infection, such as abscessed or necrosed regions, granulomata, pus-pockets, pyorrheal deposits, etc. These opacities are clearly defined, readily apparent on examination, and cannot be confused with the clear translucency of the healthy process. The area involved is indicated by the size of the shadow.

The entire alveolar process should be transilluminated from both the buccal and the lingual surfaces with light of varying degrees of intensity. Too much light will frequently flood small areas that would be readily apparent with less light. Any shadow apparent under transillumination is evidence of a morbid condition.

Tharaldsen of Northwestern University states that the opacities cast in transillumination of infected areas are due to an excess of deoxidizing hemoglobin (the relatively opaque iron compound), because of a congestion of red blood corpuscles in these areas of stasis.



THE MEDIEVAL DENTIST

Showing the early practitioner operating by candle light. Illustration from the masterpiece by Gerard Van Honhorst, Flemish painter—1592 to 1662.

He further explains that healthy red blood corpuscles reflect and readily transmit the equi-chromatic searchlight rays of the Dentalamp, showing a clear pink translucency throughout the normal process due to equalized distribution of the corpuscles in the healthy circulation. In contrast to this normal condition, it will be noted that an infected area by selective absorption absorbs certain rays of this white light, resulting in a lack of translucency throughout the diseased process due to the congestion, deoxidation and breaking down of the red blood corpuscles that have taken place in the area of stasis. The necessity of clear white light rays in transillumination is therefore evident, so that maximum reflection and transmission may be secured.

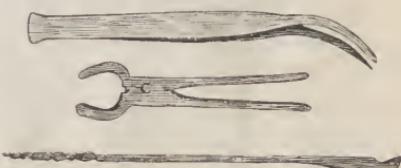
Briefly stated, the secondary sequeli caused by dental foci of infection are due to the physiological change through which the bacteria enter into the blood and are carried back again into the circulation, and then concentrate their attack at the point of least resistance in the human body, the effects of which are especially noted when there is low body resistance.

Elaborating on those pathological conditions due to root end infection, and the reason for lack of translucency during the transillumination of these areas, it will be of interest to our readers to note the following quotations from Howell's Text Book of Physiology:

"It is definitely known that by far the largest portion of the oxygen is held in chemical combination with hemoglobin of the red corpuscles, while the much smaller portion, varying with the pressure, is held in solution in the plasma. The compound oxy-hemoglobin possesses the important property that when the pressure of oxygen in the surrounding medium falls sufficiently, it begins to dissociate and free oxygen is given off.

"It has long been recognized that a certain small per cent of carbon dioxide is held in simple physical solution in the plasma and in the corpuscles, and that a certain additional amount much larger than the preceding, is chemically combined with the alkali in the blood as a carbonate. Bohr has more recently shown that carbon dioxide also forms a dissociable compound with hemoglobin, known as carbo-hemoglobin, in which the quantitative relationship of the gas to the hemoglobin differs from that shown by oxygen.

"Owing to the minute size of the corpuscles, their color when seen singly under the microscope is a faint yellowish red; but when seen in mass they exhibit the well known blood-red color, which varies from scarlet in arterial blood to purplish-red in venous blood—this variation in color



ANCIENT DENTAL INSTRUMENTS

Illustration from early Greek specimens in the Athens Archeological Museum. This collection illustrates the advance from finger to instrument extractions.

being dependent upon the amount of oxygen contained in the blood in combination with the hemoglobin.

"The arterial blood passes to the tissues nearly saturated with oxygen so far as the hemoglobin is concerned, and this oxygen is held under tension equivalent to one hundred mm. of mercury. The carbon dioxide is less in quantity than on entering the lungs and exists under a smaller pressure which may be assumed to be the same as that of the carbon dioxide in the alveoli of the lung—namely, 5.5% of the alveolar atmosphere. In the systemic capillaries the blood comes into diffusion relations with the tissues, and direct examination of the latter shows that the oxygen in them exists under a very small pressure, practically zero pressure, while the CO₂ is present under a tension of 7 to 9%. The high tension of the CO₂ is explained by the fact that it is being formed in the tissues constantly as a result of their metabolism; while the low tension of the oxygen is due to the fact that on entering the tissues this substance is combined in some way in a chemical compound too firm to dissociate. The physical conditions are therefore such as would cause a stream of CO₂ from the tissue to the blood, and a stream of oxygen in the reverse direction. It is to be remembered that in this exchange, the lymph acts as an intermediary between the tissue and the blood proper."

Delafield and Prudden in their Text Book of Pathology explain the conditions of hyperæmia in detail as follows:

"Within physiological limits the amount of blood in a part may vary considerably under vasomotor control, according to the functional necessities of the part or vascular territory. Under a great variety of abnormal conditions, the blood content suffers changes so excessive and so lasting as to be pathological. A part of the body may contain an excess of blood, a condition called hyperæmia (congestion).

"Hyperæmia may occur either through increased arterial supply, active hyperæmia (acute congestion), or through some hindrance to the venous outflow of the parts, passive hyperæmia (venous congestion).

"Active hyperæmia may occur through dilation of the arteries by the action of various physical and chemical agents directly upon their muscular coats, through the vasomotor nerves, or from the reduction of pressure upon the vessels from without. Thus irritation, injuries or stimulation of the vasomotor nerves, heat, the sudden evacuation of large exudates, trauma, or the action on the vessels of a great variety of irritants may lead to a dilation of the vessels, and to a more rapid flow of blood. Under these conditions, the affected region becomes redder, warmer and may be more or less swollen.

"Passive hyperæmia or venous congestion is due to obstruction to the outflow of blood from a part—there is an overfilling of the veins and

capillaries. The hindrance to the outflow of blood may be due to compression of the vessels from without, as from tumor, aneurism, ligature, displacement or from new interstitial tissues in various parts. It is frequently the result of thrombosis.

"If the obstruction is partial, the flow of blood is slower than normal; and diapedesis of the red blood cells may occur; the vessels are dilated; and more or less fluid may transude into the surrounding tissue. If the

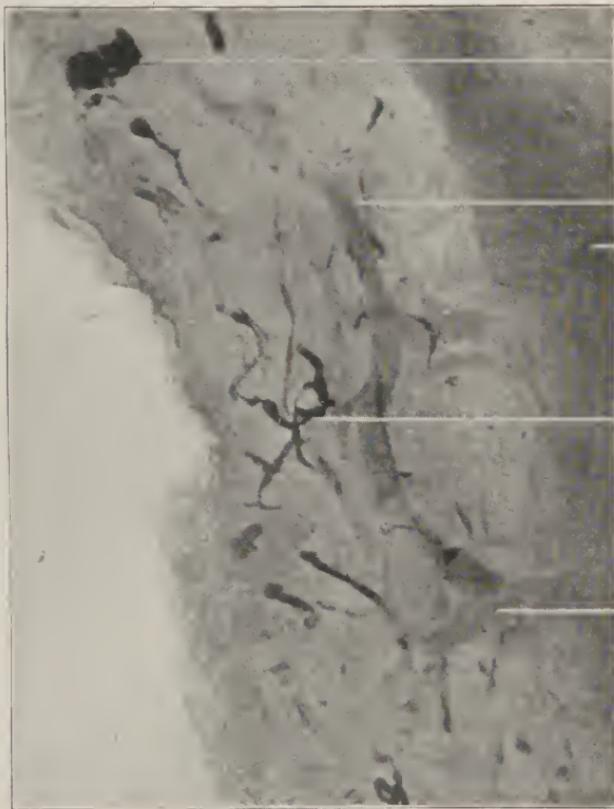


FIGURE 1
Photo-micrograph showing congestion of the blood in infected alveolar process. Reproduced from Dr. Eugene Talbot's "Interstitial Gingivitis."

obstruction is complete, the capillaries and veins in the involved region dilate; the axial stream of erythrocytes in the veins disappears; the entire lumen is crowded with them; the blood pressure rises; and the current stops. Then the red cells become packed into a homogenous mass in the dilated vessel—this is stasis. Diapedesis and transudation now occur in the capillaries and veins of the involved region. Finally, if the circulation be not re-established, haemorrhagic infarction or death of the tissue—necrosis—may follow.

"In passive hyperæmia, the tissue involved becomes more or less dark red in color—cyanotic—owing to the accumulation in the vessels of un-aërated blood; the temperature may be lowered when the area concerned is extensive; it may also be swollen in part from the distention of the vessels, in part from the extravasation of fluid; finally, there may be pulsation and increased pressure in the veins.

"If the hyperæmic condition be long continued—chronic congestion—the walls of the involved vessels may become thickened; there may be interstitial fibrous hyperplasia in the affected region; or there may be varying degrees of cell degeneration or of atrophy. Thus, function may be interfered with or suspended."

Therefore, by transillumination, the presence of shadows in infected areas may be well considered an effect principally due to deoxygenation of the blood. Of course, it is commonly known that veins of the average patient are readily located under good light, due to the darker color caused by the deaërated blood. When an apical abscess is present, there is a much more pronounced change in the blood content than in the exchange of blood to venous flow. Thus, well defined shadows are apparent when infected roots of teeth are properly transilluminated.

The presence of congested blood, which frequently occurs after the roots are filled, and always where abscesses are present, has been conclusively proven by Dr. Eugene Talbot on page 160 of his book "*Interstitial Gingivitis*," as shown in photo-micrograph reproduced on page 21.

The first thought that seems to occur in the minds of dental diagnosticians, when introduced to the transillumination idea, is that chemicals or fillings used in treating root canals will cause shadows in the alveolar process.

This misconception is all the more surprising because it is well known that congestions due to blind abscesses are frequently evidenced by visual inspection of the areas in good light even without transillumination. These discolorations of the gum tissue are always considered authentic proof of infection.

It is understood, of course, that these are cases of long standing; but it can be readily seen that a transmission of intense white light on the searchlight principle through and around the areas of recent infection would also make them evident.

The roots of healthy teeth do not give the faintest darkened area when transilluminated, nor do chemicals or fillings; such as silver nitrate, gutta-percha points, etc., used within the roots. Roots of pulpless teeth, whether treated or untreated, will not show any discoloration upon transillumination unless there is congestion in the alveolar process.

It is admitted that chemicals and fillings do frequently change the

coloration of the tooth structures. However, these chemicals and fillings do not in any way retard transillumination of the alveolar process because the light is freely reflected and transmitted through the circulation, and only passes through the dense bony process to a very limited degree. The normal cementum and dentine being very dense and not creating any shadow when transilluminated, it would be most illogical to expect a shadow from any chemical or filling placed within the root canals.

Further comparison can be made by transillumination of the fingers. No shadow is cast from the bones, the light being reflected and transmitted through the normal circulation. The veins, containing unaërated blood, are readily seen.

Even a cursory inspection of infected areas by transillumination proves that the opacities are created by the congestion and deoxidation of the blood, and not by root canal fillings or chemicals, for almost invariably the shadows are greater in area than the root structures. And, when the infected teeth are removed, the opacities remain in the alveolar process until the morbid conditions have been eliminated.

It is interesting to note that shadows found by transillumination remain until free drainage is established, and this conclusion is arrived at after observation of individual teeth for a number of years.

When congestion due to traumatism is considered, as with a "black eye," a more rapid dissipation of discoloration is found if the area is drained, as with the application of a leech; but in these cases, the changes being entirely within the soft tissues, the blood stream usually dissipates all congestion within a few days. However, the congestion present with bacteriologic infection of the alveolar process and teeth is rarely dissipated through the circulation.

Diagnosis should be established on a positive rather than a negative basis. A medical diagnostician is never satisfied with one negative Wassermann. Repeated tests of the blood are made at varying times, and frequently fluid is taken from the spinal cord, to establish, if possible, a positive determination. The same care should be taken in dental diagnosis, and any positive evidence, whether by transillumination, vitality test, or radio-

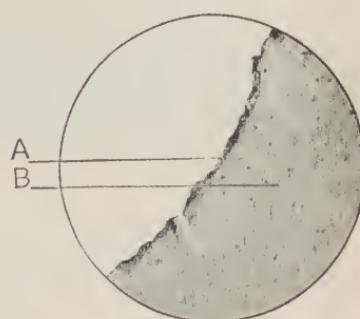


FIGURE 2

This photo-micrograph was made from a section of a tooth previously filled with Silver Cement "B" (2 per cent. silver phosphate). Note that discoloration of normal tooth structure is limited to the canal surface. Observe the slight penetration of the silver salts at A, sound dentin at B. From S. S. White Dental Mfg. Company's booklet, "Dental Cements."

graphy, should always outweigh negative deductions. Transillumination is always positive when shadows are present.

Probably the most convincing proof as to the dependability of transillumination are the findings of Dr. C. H. Davies quoted on Pages 27 and 28 in which he gives definite clinical evidence for three thousand cases in which shadows were present—*infection being proven in every instance upon extraction.*

The use of transillumination properly employed in the examination of a few patients will enable any one to quickly recognize the value that can be placed on this method of determination; every shadow being due to a pronounced deviation from normal.

It should be remembered that all diagnoses by transillumination are better accomplished in a dark room.

CHAPTER IV

EXPLANATION OF THE DENTALAMP AND THE SEARCHLIGHT PRINCIPLE

An explanation of the Dentalamp and the searchlight principle used in its construction will now be of interest. The diagrammatic illustration, Figure 3, shows the Right-Angle Dentalamp, which is the only lamp correctly curved for examination and transillumination of the posterior and



FIGURE 3

Diagrammatic illustration showing the Searchlight and Vacuum construction of the 100 candle-power Dentalamps.

anterior dental process. The curvature makes it possible to project the light directly at right angles through the area being examined, and this cannot be done with the ordinary type of lamp.

The Dentalamp, being constructed on the principle of a searchlight, with a powerful bulb, reflector and lens, provides a greater concentration of light than any other lamp of similar voltage. Light from ordinary lamps

has very little value for the determination of pathological conditions in the soft tissues, due to the presence of orange and red rays. So these rays are filtered out of the Dentalamp, resulting in the white equi-chromatic light necessary for dependable diagnosis. Because of the extreme penetrating power of the x-rays, radiographs do not indicate infection in the soft tissue unless pronounced dissolution is present. The roentgenograph is merely a picture of variation in densities.

The white opalite used in this lamp is an insulating material, so there is no possibility of electric shock to patient or operator. There are no rough or uneven surfaces to retain saliva, and, unlike metal handle mouth-lamps, the Dentalamp is clean and inviting and does not turn dark nor corrode.

To prevent excessive heat, the Thermos bottle principle is employed in the manufacture of this lamp, for it is a well known fact that heat, as such, cannot pass through a vacuum. The intense concentration of light with so little heat is a source of great satisfaction to every user.

Dentists who follow inefficient methods of sterilization, such as wiping lamps off with alcohol, should consider their responsibility to the public and avoid the possibility of transmission of infectious and contagious diseases. The limitations of alcohol sterilization have been repeatedly proven, an interesting case being recorded in the Boston Medical and Surgical Journal, by Drs. Robert N. Nye and Tracy B. Mallory, as follows:

“Two post-operative deaths within forty-eight hours at the Boston City Hospital, from infection with the sporogenic, *B. aërogenes capsulatus*, led to this study.

“As a matter of operating-room routine, all scalpels, scissors, etc., had always been washed thoroughly in hot soap and water, rinsed in scalding water and then stored away in the instrument cases. Before using they were placed in sterilizing solution (70 per cent alcohol) for five to twenty minutes.

“In order to determine the effect of the operating-room sterilizing solution (70 per cent alcohol) on a gas-producing sporulating anaërobe, a number of experiments were performed which definitely showed that **immersion in alcohol (70 per cent) for one hour will fail to sterilize instruments grossly infected with bacilli belonging to the *B. aërogenes capsulatus* group.**

“It may be mentioned parenthetically that it is generally accepted that 70 per cent alcohol possesses greater germicidal action than higher or lower concentrations.”

Cameron's Dentalamp may be sterilized by boiling, steam pressure and by the Harvey incineration method, as well as by cold antiseptic solutions, described in detail in Chapter VII.

The Vitrohm Potential Adjuster is constructed so that the Dentalamp may be used on any electric light current. This reduces the city current to the correct voltage and amperage, avoids the danger of burning out lamps, and provides variation in the intensity of the illumination to meet every requirement. The Vitrohm Potential Adjuster is compact, portable, and will not burn out nor short-circuit. As no series lamps are used in reducing the current with this equipment, there is no interference in dark-room transillumination.

With the Dentalamp, diagnosis by transillumination has passed beyond the stage of a theory into the realm of proven fact. Many thousands of physicians and dentists are today using this method to make immediate and accurate diagnoses. The advantages are so apparent as to make any elaboration on this phase superfluous. It must, however, be stated that the definite manner in which transillumination shows up an infected area is surprising when first viewed. In fact, when making a diagnosis with the Dentalamp, the operator is not so much looking at a non-translucent area as viewing the actual condition of the dental process.

Congestions of the circulatory system in the areas about infected teeth, as has been stated, are plainly indicated by a relative lack of translucency of the alveolar process.

Transillumination of a blind abscess with the Dentalamp immediately gives an indication that the condition exists, and usually long before it can be pictured by radiography. It is an established fact that decalcification, absorption or necrosis of the bone substance must take place before a definite indication of abscessed or other infected areas can be obtained by radiography. The varied density of radiopacities and radio-lucencies, and the many irrelevant reasons possible for their existence, aside from indications due to pathological change in the bone structure, tend to confuse in radiographic diagnosis. With transillumination, regardless of the extent or density of the discoloration in the process, only one thing is the cause, and that is congestion due to morbid change.

Talbot, in his research on bone absorption around the roots of teeth, reports that dental x-ray pictures do not show the necessary evidence for accurate guidance in the treatment of interstitial gingivitis, pyorrhea alveolaris, or apical changes.

From observation of thousands of cases as Supervising Dentist of the Chicago Municipal Tuberculosis Dispensaries, Dr. C. H. Davies states that the x-ray is of little value in diagnosis of infected conditions in the alveolar process of children.

When six-year molars erupt, the roots are not fully developed; and, in fact, while supposed to develop in four, are frequently not fully developed until after eleven years. Due to this undeveloped condition of

the roots, and the fact that frequently the roots of abscessed teeth are absorbed, both conditions look very similar on a radiograph. Then, too, there is confusion on x-ray films from overlapping of deciduous tooth roots with crowns of undeveloped permanent teeth growing into place in the process.

In these cases, it takes a good radiograph and a most careful inspection to determine whether the condition is physiological or pathological, and even the expert radiographer is usually uncertain. Whereas with transillumination, if a shadow is present, the existence of infection is definitely established. See Figures 4 and 5. As the roots of these teeth have not fully developed, the canals are usually larger at the apex than at the pulp chamber, and only soft tissue exists at the root end. If infection is present, treatment would be useless and the teeth are therefore extracted.

Davies further reports that this use of transillumination has proven entirely dependable in the children's clinic, and affords a quick and accurate diagnosis in practically 100 per cent. of the cases during the first visit.

From experience, it will be readily conceded that when both the Dentalamp and the radiograph indicate infection or absorption, a much more definite idea of the condition can be obtained by transilluminating the process and actually seeing the entire area involved, than depending upon shadow pictures—a secondary procedure. Transillumination is the best means of locating pathological conditions affecting the soft tissue; such as periapical infections, pyorrhea alveolaris, interstitial gingivitis, serumal deposits, salivary calculi, etc.

Before going into the details of the use of the Dentalamp in diagnosis by transillumination, it will be of interest to note the results obtained by Davies at the Chicago College of Dental Surgery, who reports on more than 3,000 cases. When non-translucent areas were found, the teeth were extracted and infection was actually dem-



FIGURE 4

Radiograph of process in eleven-year child. The overlapping of crown of permanent tooth with roots of deciduous tooth makes diagnosis of the bicuspid region uncertain. First molar appears to be fully developed and healthy.



FIGURE 5

Transillumination of same area as in Figure 4. Bicuspid region of process at second deciduous molar is clear and healthy. Shadow at first molar—upon extraction, found roots not fully developed and pronounced infection present.



FIGURE 6

Opaque area indicating infection in the dental process during transillumination before extraction.

that were present before extraction remained after the removal of the tooth, proving further that morbid change had taken place outside the tooth structure and that the presence of these discolorations was due to areas of stasis and not to mechanical causes, such as chemicals or root canal fillings.

In many of these instances where the opaque areas persisted for several days after the extraction, it was necessary to remove the diseased process with a surgical bur or curette to avoid residual sequelæ. The post-operative treatment of such conditions deserves special consideration, as free drainage should always be established and maintained to prevent the formation of a blood clot or cicatricial tissue, which would be ideal culture media for bacterial growth.



FIGURE 8

Transillumination of the alveolus after the infection has been eliminated, showing return to normal coloration.

onstrated as being present in every instance in which the Dentalamp showed an opaque area.

The morbid specimens secured from each extraction provided interesting evidence even under superficial examination, because of the diverse types of infection represented. These were indicated by absorption of the roots of the teeth, pus sacs, cysts, granulomata, destruction of the peri-dental membrane, and other well defined pathological conditions.

In all of these cases, the discolorations



FIGURE 7

Showing the opaque area in the alveolar process by transillumination immediately after extraction.

The various types of shadows found in these three thousand cases might be roughly divided into three groups:

Group 1—Dark areas, larger than the root structure, extending from apex to gingiva, as shown in Figure 9.

In such cases it is self-evident that the shadows are due to congestion outside the tooth structure.

Group 2—Shadows extending from the apex to the gingiva, but covering

about one-half the width of a cross-section of the root structure, as illustrated in Figure 10.

Sometimes these shadows can be seen on only one surface of the alveolar process, buccally or lingually, depending on the location of the congestion, and occasionally are confusing to those who have had limited experience with transillumination. Radiographic diagnosis of such conditions is not practical, because the infection is mainly within the periodontal membrane.

On extraction, the determining evidence is found to be the denudation of from twenty to thirty per cent. of the periodontium from the root structure, and frequently a sac about the size of a pin-head appears at the apex of the tooth. This condition is present more frequently with single-rooted teeth.

Even in such cases where there is no destruction of the bone substance, the shadows remain for several days after extraction, and frequently necessitate surgical removal. This further emphasizes the value of transillumination in locating residual areas which might have

as serious an effect on the general health of the patient as if no extraction had been made.

Group 3—Well-defined opacities usually wider than the root structures, but extending only about one-third the way from gingiva to apex, as shown in Figure 11.

Confusion frequently arises with these conditions because the congestion does not extend from the gingiva to the apex. However, with uncrowned teeth apical infection may be safely assumed to be present, if there are no pyorrhreal indications. The reason the shadows are not evident throughout the whole root area, as illustrated in Figure 9, is because the infection has localized between the roots of the teeth, and usually manifests itself



FIGURE 10
Shadow one-half width of cross-section of root structure, explained in Group 2



FIGURE 9
Shadow larger than the root structure, explained in Group 1.

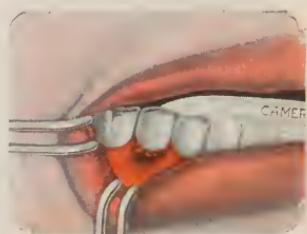


FIGURE 11
Shadow extending only part way from gingiva to apex, explained in Group 3.

on extraction in the form of an interradicular cyst or abscess.

When the teeth are crowned, shadows extending part of the way from gingiva to apex may or may not be caused by apical involvement. Such dark and congested areas may be due to pyorrheal pock-ets, gingivitis, trauma from impingement of crowns, overhanging fillings, malocclusion, etc. The predominating factor in diagnosis of these cases is the determination of pulp vitality with the Vitalitester. This subject is described in greater detail in Part Two.

CHAPTER V.

PRACTICAL DETAILS ON DIAGNOSIS BY TRANSILLUMINATION

Figure 12 illustrates transillumination of the process surrounding an infected upper right central incisor, with the dark area plainly indicating infection. A smaller area, not so greatly discolored but well defined, would indicate a morbid condition as positively as would a larger and darker area.

Infection of the most virulent type may be indicated by a shadow of very moderate size and density. The purpose of diagnosis by transil-lumination is to locate dark areas, and when these are present, a patho-logical condition is definitely established. The shadow, as shown in Figure 12, follows the contour of the tooth root, indicating that only this tooth is involved. Infection of several proximating teeth would be indi-cated by a discoloration throughout the entire area of stasis.

As has been noted, the darkened area does not clear up immediately upon extraction of the tooth. In this respect, transillumination is of

additional value, for by observing the gradual change to normal translucency in the area of extraction, the diagnos-tician has a definite means of knowing when congestion has been eliminated. When these areas show complete restoration to healthy coloration, the dangers of residual infection may be assumed to be past.

Figure 13 shows a typical shadow in-dicating infection of the lower left central incisor. The opacity in the alveolar process indicates an area of stasis sur-rounding this pulpless tooth, and is pos-itive evidence of pathologic change.

Figure 14 illustrates a shadow at an



FIGURE 12

Showing the lack of translucency of the process surrounding an abscessed upper right central incisor.

infected upper first molar. Satisfactory diagnoses of abscessed upper molars can occasionally be made by using the Antralamp and projecting the light as shown in Figure 24, noting the presence of shadows on the hard palate. In this examination a piece of rubber tubing should be used over the lamp to concentrate the light, and the lens should be pressed downward in the center of the eye orbit, pointing directly through the maxillary sinus toward the median line of the palatal arch. The hand may also be used to confine the light in making this diagnosis. If any of the upper teeth are infected, opaque areas, usually

about 5 mm. in width, are occasionally observed extending well up on the palate.

Because of the proximity of the maxillary sinuses to the upper molars, infection of the antrum of Highmore is common, and it is always well to make an examination for sinus involvement, when any of these teeth are abscessed. Diagnoses of the maxillary sinuses are made with the use of the Antralamp, as explained in Chapter VI.

FIGURE 14

Transillumination of the infected alveolus of an abscessed upper left first molar.

dental process surrounding an infected lower left first molar. Remember that it is always advisable to make the examination from both the buccal and the lingual surfaces of the alveolar process of every suspected tooth.

It is impossible to recommend a therapeutic procedure where transillumination shows shadows surrounding the tooth structure, and no routine technique could be



FIGURE 13

Appearance of an infected lower left central incisor during diagnosis by transillumination.



FIGURE 14

Transillumination of the infected alveolus of an abscessed upper left first molar.

Figure 15
shows trans-
illumination
of the den-



FIGURE 15

Illustrating transillumination of infected dental process surrounding a lower left first molar.



FIGURE 16

Transillumination of abscessed tooth draining through a sinus on the gum. Note absence of opaque area in process.

safely prescribed for these conditions. When the patient is apparently suffering no ill effects, and the tooth is performing a particularly useful function, it would seem to be poor policy to invariably recommend extraction. However, when there is evidence of sepsis, and all other possible foci of infection show negative, infected areas indicated in the alveolar process by transillumination may be suspected as the primary cause.

A blind abscess at the root of a tooth is a constant source of general systemic auto-intoxication, and, through systematic scientific investigation, we have learned that all therapeutic measures at our command are

incapable of completely devitalizing the invading organisms which produce these toxins. Every blind abscess instantly reveals itself by a shadow when the Right-Angle Dentalamp is used.

It will be conceded, of course, regardless of when treatment is administered, that knowledge of the presence of morbid areas is of great value to both the diagnostician and the patient.

The following conditions, which are occasionally found, may or may not be indicated by shadows in transillumination, depending on the presence or absence of localized congestion in the alveolar process:

Abscessed teeth where complete drainage has taken place through a fistula draining on the gum, as shown in Figure 16. Careful search should always be made for fistulae, or scar tissue which would indicate prior drainage.

A condition found with broken down six-year molars is illustrated in Figure 17. There being a third degree cavity in these cases, it is usually possible to insert an explorer through the canal to the apex of these teeth. Frequently, pronounced infection is demonstrated upon extraction in such cases; but the free drainage that has taken place through the pulp canals, caused by the pressure of the carboxyhemoglobin gas, has eliminated the congested blood, permitting transmission of the white rays.

Occasionally there is drainage through the peridental membrane, and the opening



FIGURE 17

No shadow in alveolar process, because of free drainage taking place through carious crown.

at the gingiva can be found with an explorer; or the tooth may be loose, because of destruction of the periodontium, drainage taking place at the gingival margin.

The absence of shadows in any of the cases explained above is not usually a predominating factor in the diagnosis, as the conditions are self-evident.

There may be an acute inflammation and swelling of the cheek or jaw, due to an infected tooth, with no opacity during transillumination because the congestion has not yet localized.

With acute pulpitis, impacted molars, malformations and fractures of the jaw, there is usually no shadow.

Occasionally, areas of condensing osteitis may be indicated on a radiograph, usually in areas where the teeth have been extracted, but there may be no shadow by transillumination. Sometimes the patients report having had a drainage, but frequently the history is obscure. Residual infections are present in these cases, but there is a dissemination of the congestion through the blood-stream.

When a filled tooth without a shadow is found, because of complete drainage taking place, as will occasionally be the case, it will act as further confirmatory evidence of former statements that root canal fillings and chemicals do not create shadows.

However, it may be safely accepted that in average dental practice more than 90 per cent of all apical infections are indicated by shadows in the alveolar process during transillumination on the searchlight principle.



FIGURE 19

Transillumination of bicuspid teeth at which calculus deposits are present.



FIGURE 18

Showing clear translucency of healthy process surrounding a pulpless tooth.

The enamel of most pulpless teeth is discolored and without lustre as compared to vital teeth. It is advisable to hold the searchlight lens on the interproximal space to secure a comparison of color of proximating teeth as shown in the illustration, Figure 18; but attention is emphatically directed to the use of the Vitalitester as the only certain method of determining pulp vitality.



FIGURE 20

An advanced stage of Pyorrhea Alveolaris by transillumination.

tions at the gingiva, and the forerunner of pronounced pyorrhea, is lack of translucency, and even in the incipient stages of the disease, a discoloration of the gum tissue, decidedly different from the normal healthy translucency, will be noted by transillumination.

Many patients refuse to believe that they have pyorrhea unless there is pronounced suppuration or lack of adhesion. By the use of the Dentalamp and scaler, the diagnostician can reveal obscure conditions in the early stage to doubting patients, and in this way emphasize the necessity of treatment in time to save the teeth.

The full extent of pyorrheal deposits is very easily seen by the aid of transillumination with the Dentalamp, which is in every way more satisfactory than radiography in these conditions. Its use is not confined to diagnosis alone, for as the infection is gradually eliminated by treatment, transillumination serves to indicate the progress of prophylactic procedure, and in this way reduces the danger of traumatism from over-instrumentation.

Figure 20 illustrates an advanced stage of pyorrhea alveolaris with gums retracted and shrunken, and pus welling from the margins. The discoloration indicates the extent of the infected area.

Occasionally pyorrheal conditions, accompanied by sponginess of the gums and destruction of the periodontal membrane, are indicated by a bright crimson line on the septa alveoli of the teeth involved, and this deviation from normal healthy trans-

The best results in modern dentistry are obtained in the field of prophylaxis, and preventive treatment is especially effective in incipient pyorrhea. Every dentist and physician should be equipped to make examinations for these conditions, and this can best be done by the use of the Dentalamp.

By transilluminating at the gingiva, calculous deposits are easily distinguished by crescent-shaped shadows of varying size and density, as shown in Figure 19. These areas provide a fertile field for the inroads of pyorrhea.

The first evidence of abnormal condi-



FIGURE 21

Showing bright crimson line in incipient pyorrhea, and pyorrheal pus pocket at first bicuspid.

lucency is immediately evident. See Figure 21. This shows the first indication of a congested area before breaking down of the corpuscles has set in, and consequently no pus or debris has accumulated to create a dark-shaded area by transillumination. As a diagnostic aid, transillumination far excels radiography in these early stages of infection, because of the selective efficiency of the white equi-chromatic rays of the Dental-lamp which definitely indicate even the slightest change from normal, as compared to the high penetrating power and low absorption of the x-rays which utterly fail to differentiate unless the infection has advanced to the point where pronounced structural change has taken place.

Isolated pyorrheal pockets can be readily determined by discolorations over the areas involved, also illustrated in Figure 21.

Many of the chronic systemic conditions indicated on Page 15 are the result of secondary infection from absorption of pyorrheal toxins, so it should not be necessary to elaborate on the dangers to the general health of the patient in permitting such conditions to remain. While, in certain cases, it may seem better to let an abscessed tooth remain in situ, there is no excuse for neglecting the treatment of pyorrhea.

It is therefore evident that an efficient means of determining the extent of the incipient as well as the advanced stages of these various conditions is invaluable as a diagnostic aid.

CHAPTER VI.

USE OF TRANSILLUMINATION FOR DIAGNOSES OF THE AIR SINUSES

Leading authorities are agreed that transillumination is the most effective method for diagnoses of the air sinuses. Because of the proximity of the maxillary sinuses to the dental process and the relation of the frontal to the maxillary sinuses, there is frequently an extension of infection from one to the other, emphasizing the necessity for accurate diagnosis.

The diagnostician is frequently confused by the radiopacities and radiolucencies in x-ray diagnosis of the air sinuses, and in many instances the radiograph falsely indicates infection by reason of cloudiness—while transillumination shows the sinus to be normal by reason of equal translucency.

Frequent failure to find pus, polypi or tumorous growths in these cases and the proven



FIGURE 22
Illustrating the close relationship between the dental process and the principal air sinuses.

dependability of transillumination through corroborative exploratory diagnoses and post-operative findings, convince the careful diagnostician of the superiority of this more modern method.

The disadvantages of earlier transilluminating outfits have been the greatly diffused light and the extreme heat generated. The constant danger of burning the patient limited the period of examination to such a degree that the results secured were not always dependable, and until the advent of the searchlight principle, there was not sufficient concentration of light for accurate determination.

Diagnosis of the alveolar process by transillumination may be done in the light of the average office, provided the mouth is not flooded with light. However, a dark-room is of vital importance, and is most valuable to the specialist and diagnostician in locating obscure sources of infection.

A dark-room can be installed at small expense, if made out of wall-board or canvas. Where there is not sufficient space for a permanent dark-room, the suggestion of Dr. Douglas MacFarlan, as published in the *Eye, Ear, Nose and Throat Monthly*, will be of interest. It consists of a pair of square wooden frames hinged together at the top, one serving as a wall support hung from metal eyelets fastened to it, and the other serving as the dark-room top when in use —extended and held in place by two folding brackets as illustrated in Figure 23. The frame is covered with black fabric or photographer's focusing cloth, sewed together, and tacked on to exclude all light except at the bottom, which is left open for entrance and pulled tight to the bodies of the occupants during transillumination. By hanging a wall-mirror in the dark-room, patients can frequently be shown the conditions.

When a dark-room is not practicable, a photographer's focusing cloth will serve the purpose by throwing it over the heads of both patient and diagnostician during the examination.

Full explanation, together with physiological and pathological confirmation, of the cause of shadows or opacities in transillumination of infected areas is given in Chapter III. That the reason is the same, regardless of the area affected, is further verified by Skillern, who states in his textbook on diseases of the accessory sinuses of the nose: "The shadow obtained on transillumination of the region of an infected sinus is not due



FIGURE 23
Frame and folding dark-room to hang from wall
in offices where space is limited.

to the pus contained therein, but rather to the congested membrane lining the sinus so affected."

The most dependable method for diagnosis of maxillary sinus infection is to transilluminate with the Antralamp from the infra-orbital ridge through the eye orbit, as shown in Figure 24. This lamp being only 5 mm. in diameter is ideal for insertion into the eye orbit, and furnishes a very brilliant concentrated light. The lamp is pointed directly toward the center of the mouth, and the translucency noted on the palatal arch. When the maxillary sinus is infected, there will be little or no light transmitted through the hard palate.

If an equal pink translucency is present on corresponding opposite sinuses, it may be accepted that the sinuses are normal. If one sinus shows dark by relative comparison with the other, infection may be assumed.

Occasionally, diagnosticians express doubt as to the efficacy of this method, claiming that sometimes there is a complete absence of or thickening of the bony process of one sinus. In examining thousands of cases, the author has never found a condition where transillumination was impractical for this reason in either frontal or maxillary sinus diagnoses. Those who doubt the value of transillumination, because of the occasional difference in size of sinuses on the same individual, need only consider the translucency or lack of it, and not the size of the area transilluminated, to avoid confusion.

A definite diagnostic check is often obtained by inserting the Antralamp into the nares and noting the translucency of the palatal arch, and this, as well as the oral method, is recommended in all doubtful cases.

In diagnosis of the maxillary sinuses, it is important to bear in mind that if the indications show infection and no pus or debris is found, the lack of translucency may be due to a tumorous growth or congested membrane. It need scarcely be stated that a definite diagnosis by transillumination can only be determined by relative comparison, and a lack of translucency with both maxillary sinuses should not be attributed to double infection without accompanying confirmatory symptoms or exploratory diagnosis.

The infra-orbital method is the most dependable, because the light is transmitted from the infra-orbital ridge through the sinus to the palatal



FIGURE 24

Showing method of transilluminating from the eye orbit into the palatal arch for antrum and upper molar diagnoses.



FIGURE 25

Transillumination by the infra-orbital method to the buccal plate for location of infected impacted upper molars.

of usefulness in all delicate surgery, and being sterilizable, it may be safely inserted into the maxillary sinus through the socket of an extracted



FIGURE 26
The Antralamp for infra-orbital transillumination and delicate surgery.

tooth or through a surgical opening, as illustrated in Figure 27. The Antralamp is also used in exodontia for illumination of the alveoli in the location and removal of broken-off roots.

Transillumination of the maxillary sinuses by the oral method must be made in a dark-room with the Straight Dentalamp. If the patient has an upper dental plate, it must be removed. The lamp should be held in the mouth with the searchlight lens against the palatal arch on the median line with the mouth closed. The rays should be directed at an angle to project through the sinus to the eye orbit. After inserting the lamp, move it slowly backward and forward, and from side to side, noting transmission of light.

In a normal case, Figure 28, both eye orbits

arch without any interference from facial structures. With this method there is no confusion from dark pigmentation or density of the buccal walls, as with transillumination per os.

This same method has proven of great service in the diagnosis of infected impacted upper third molars, the translucency being noted on the buccal plate, as shown in Figure 25.

Even when a dark-room is not available, a satisfactory diagnosis of the sinuses or dental process by the infra-orbital method can frequently be made, by the exclusion of direct exterior light.

The Antralamp, illustrated in Figure 26, was designed from the suggestion of Dr. E. C. Moore. This lamp has a splendid field



FIGURE 27
Illustrating the Antralamp inserted into the maxillary sinus through the alveolus.

are equally pink and translucent. There may be a red pupillary reflex through the eye, and the patient should get a sensation of light when the eyes are closed. There will also be a pink translucency throughout the malar region, dependent upon the varying density of the bone and muscle structures. Patients with dark complexions or with heavy malar proc-



FIGURE 29

Appearance of left maxillary sinus infection during transillumination—note contrast.

eye orbits. These discolorations may be due to heavy bone or muscle structure, and may be disregarded in diagnosis when they can be partially or entirely eliminated by pressure with the fingers over the areas while transilluminating. The important indication is transmission of light at the eye orbits. Figure 29 shows the light transmitted through the eye orbit and malar region on the normal side. There is no translucency nor pupillary



FIGURE 28

Transillumination of both maxillary sinuses in a normal condition—note equal translucency.

ess, of course, will not show the same translucency as that of a light-boned or light-complexioned person.

It will be noted that frequently the malar process is not clearly transilluminated by the oral method, though the translucency is pronounced at the



FIGURE 30

Illustrating clear translucency of a normal frontal sinus during diagnosis by transillumination.



FIGURE 31

Lack of translucency of an infected frontal sinus during transillumination by the Searchlight Principle.

well into the ear, and if normal, transillumination will be observed behind the ear through the mastoid region of the temporal bone. Normally, both mastoid processes should be equally translucent. If one side shows a normal pink glow and the other side is dark, it is evidence of infection. This diagnosis should always be made in a dark-room.

Involvement of the various sinuses is most frequently due to the extension of infection from adjacent structures—often diseased teeth, the nose, ear, etc. Antral trouble is very often accompanied by one or more of the following diseases: Arthritis, sclerosis, neuritis, anemia, indigestion, septicemia, arteriosclerosis, endocarditis, corneal ulcer, nephritis, gall bladder infection, ulcers of the stomach, intestinal disturbances, chronic headache, etc. Even though the physician or dentist may not care to offer treatment for infections of the air sinuses, patients will appreciate a careful diagnosis.

Dependable as transillumination has proven to be in this field, corroborative evidence should always be sought.

reflex on the left side, which is an indication of pathological change.

Transillumination of the frontal sinuses should be made in a dark-room. The Straight Dentalamp is used, and the lens placed against the supra-orbital ridge, well back under the floor of the sinus. A piece of rubber tubing or the operator's hand should be used to concentrate the light. A normal sinus will be pink and translucent, as in Figure 30; and the light will not transmit through an infected sinus, as in Figure 31.

Figure 32 shows the Antralamp used for transillumination of the mastoid cells. The Antralamp is inserted



FIGURE 32

Transillumination of normal mastoid cells by the use of the 5 mm. Antralamp.

It should be noted that transillumination is frequently of value in locating foreign bodies imbedded in the hard and soft tissues. W. W. Jackson, M. D., reported an interesting case in *Dental Facts*:

"Mr. E. A. _____, Alton, Illinois, age 57, stationary engineer, had an attack of pain in the right mandible, which he assumed to be toothache. His dentist extracted the tooth which he thought was the cause of the trouble, with no relief. In succession, all of the teeth to the median line were extracted, with no improvement. For several years he suffered from recurrent spasms of pain, neuralgic in character, short in duration, and varying from a few minutes to several hours apart, always located in the lower right bicuspid region.

"On examination, a radiograph was made; and this revealed about three-eighths of an inch of the shaft and eye of an ordinary sewing needle imbedded in the dental process. Repeated attempts were then made by stereopticon plates and radiographing in two diameters to determine the exact location, buccally and lingually, of the foreign body. This did not prove to be practical.

"Cameron's Right-Angle Dentalamp was then used in transilluminating the area and this revealed the needle plainly. The transillumination was through the mandible from within outward. The needle was removed under local anesthesia. The jaw was trephined from the outer side as there was no way of determining depth, although the location was perfect in transverse diameter before opening the canal. The needle was entirely within the medullary canal on the lingual side in contact with the nerve."



FIGURE 33

Radiograph showing the needle imbedded in the alveolar process.

CHAPTER VII

THE PROPER EQUIPMENT FOR DIAGNOSIS BY TRANSILLUMINATION, ETC.

Figure 34 shows the Straight Dentalamp for transillumination of the maxillary and frontal sinuses, and for examination of the oral cavity



FIGURE 34
The Straight Dentalamp.



FIGURE 35
The Detachable Mirror.

and the teeth with the detachable mirror shown in Figure 35. The mirror is boilable and made in all sizes, plain or magnifying.

The Straight Dentalamp with the detachable mirror furnishes a cool operating light for locating deposits and obscure cavities by direct illumination. See Figure 36. In this way the lamp can also be used very effectively to determine conditions of the tissues in the mouth, throat and post-nasal region.

Figure 37 illustrates the Straight Dentalamp with detachable mirror. The psychological effect of showing the patient conditions of the mouth in a hand-



FIGURE 36

Using the Straight Dentalamp with mirror attached for examining the teeth, mouth and throat.

mirror is important. A satisfied patient is a great asset.

Figure 38 shows the Right-Angle Dentalamp, for transillumination of the dental process and crowns of the teeth, for extraction of impacted molars, and for root canal procedure.

Transillumination can also be used effectively for the detection of interproximal cavities, intercoronal caries and the extent of fillings in the crowns



FIGURE 37

Showing the patient conditions of the teeth and mouth with the aid of a hand mirror.



FIGURE 38
The Right-Angle Dentalamp.

of teeth, etc. Figures 39 and 40 show how such areas appear when transilluminated.

The Dentalamp is also of value in locating areas of recurrent decay, which, due to decalcification, are indicated at margins of fillings by differences in lustre and color. They are easily shown to the patient, and quickly proven by the use of a scaler or explorer.

The instant, complete and accurate determination of these conditions presents an opportunity to proceed with all necessary treatment at the first sitting, and permits advising the patient fully and immediately of existing pathological conditions.

Cameron's Dentalamp enables the operator to work with equal ease on bright and cloudy days, and avoids the necessity of postponing appointments due to bad light conditions.

Every dentist knows how difficult it is to work in root canals. Transillumination is of great service to the careful root canal operator, as it permits observation of the progress of instrumentation.

Dr. Edwin J. Nestler, Department of Advanced Courses in Dentistry, Columbia University, reports on the use of transillumination in connection with root canal procedure as follows:

"In no field of dental science is illumination more necessary than during root canal work. It is a recognized fact that the cutting away of a certain amount of healthy tooth structure to gain ready access to the canals is good dentistry. But even then, by direct illumination it is frequently impossible to locate the canals. It is here that transillumination is of great value.

"There is no step in root canal procedure which is of such great importance as in the locating and shaping of the orifices of the canals.

Too often an otherwise good operation is spoiled by cutting here and there into the floor of the pulp chamber. But if, after removing the overhanging walls of the chamber, the tooth is transilluminated, the orifices of the canals are easily discerned. Then, by using the proper bur, a funnel-shaped opening is made and subsequent access to the canals is a simple matter, as the various instruments easily slide into place.

"Again, consider how many teeth



FIGURE 39

Detection of interproximal cavities and intercoronal caries by trans-illuminating crowns of the teeth.



FIGURE 40

Determination of the extent of intercoronal fillings by the use of transillumination.



FIGURE 41

Illuminating the mouth and retracting the cheek with the Right-Angle Surgilite.

gual, dependent upon which canal it is desired to see into. It is surprising how readily the tooth is illuminated, and how distinctly the interior of the canals are shown. Frequently in single-rooted teeth, when the canal is straight, one can see down to the apex, and often debris is in evidence, even after most careful instrumentation."

The Right-Angle Dentalamp is of special service to the oral surgeon and exodontist, when chiseling out impacted molars. On account of its curvature, the light can be easily projected directly into the field of operation.

The Right-Angle Surgilite, as illustrated in Figure 41, has met with great favor in exodontia, and for all work within the mouth where a combination retractor and cool operating light is desired. It is about 12 in. long with a convenient handle, so that the patient or the assistant can illuminate the entire oral cavity and retract the cheek or tongue from the field of operation.

Figure 42 shows the Lenslite attached to the Straight Dentalamp. This lens magnifies the field ten diameters, and is of great service in cavity preparation, for inspection of margins of inlays, crowns, etc., and also in examination of the gum tissues.

have more than the average number of root canals. Frequently these small canals are blocked by the 'pick method' of locating canals. True enough, this method has its place, but how much better it is to see the canal first and then pick it out with an instrument.

"During this transillumination, the lighted portion of the Right-Angle Dentalamp is covered with rubber tubing and the lens directed at about one-half to two-thirds the way toward the apex on the respective side, either buccal or lin-

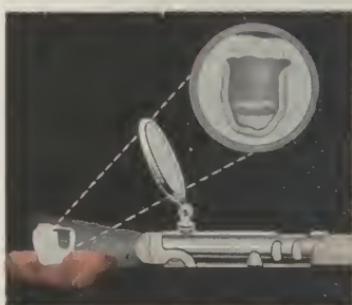


FIGURE 42

Showing assembly of the Lenslite on Straight Dentalamp for use in cavity preparation, etc.

Careful operators are no longer satisfied with unsanitary, unsterilizable metal-handle mouth-lamps and condemn their use, because they expose healthy patients to active infection. Cameron's Dentalamps are the only lamps that can be readily, completely and safely sterilized.

These lamps are scientifically constructed to withstand sterilization by boiling or steam pressure; but a quicker way is to use the following adaptation of the method described by Lieutenant Commander H. E. Harvey, Dental Corps, U. S. N., in the April, 1921, issue of the *United States Naval Medical Bulletin*, for the sterilization of dental engine hand pieces.

For the Harvey method, the only apparatus needed is an ordinary two-ounce bottle of denatured alcohol and a medicine dropper. The dropper serves as the stopper when not in use, and because it fits loosely into the bottle may be removed and returned for more alcohol with one hand while the other is engaged in holding the lamp.

Hold the lamp by the coil spring just above the bakelite socket, and cover all exposed surfaces of the lamp, including the bakelite socket, if desired, with alcohol. Then ignite the alcohol at once, and as it is burning, drop on additional alcohol to keep the flame alive and completely incinerate existing bacteria. See Figure 43. The repeated use of this method does not damage the Dentalamp and ensures speedy and complete sterilization.

Incineration should be done over a cuspidor, wash-basin, or other non-inflammable surface and the dropper should be held at a safe distance above the flame. With a little care and experience, there is no danger by following the above procedure; but if an additional safeguard is deemed necessary, a pair of pliers or forceps may be used to grasp the bakelite socket, leaving the entire lamp free for sterilization.

There is a positive advantage in sterilizing the lamps in this way in the view of patients, as it will impress them with the precaution taken.

The following bacteriological tests were made at the request of Dr. Harvey at the Naval Medical School to justify the use of the above method:

(a) Instrument, after being thoroughly sterilized to eliminate existing contamination, was treated with a bouillon culture of *staphylococcus pyogenes aureus*, taking care to work the culture into the crevices. This



FIGURE 43
Sterilizing the Dentalamps by the
Harvey method.

organism was selected, as it was considered as resistant as any of the ordinary mouth organisms.

- (b) The instrument was then sterilized according to the indicated technique (applying alcohol with dropper and igniting the same). Subsequent immersion in bouillon failed to yield a growth.
- (c) As a check on the above, the instrument was treated as in paragraph (a), and immersed in bouillon without sterilizing, resulting in a pure culture of staphylococcus. A growth was likewise obtained when the instrument, treated as in paragraph (a), was followed by alcohol without igniting.

The results of the above tests certify the efficiency of the Harvey method.

Cold antiseptic solutions may be used for sterilization of the Dentalamps, when the above methods are not convenient. The following are recommended: Chlorazene—one tablet to two ounces of water; formaldehyde, 4%; phenol, 10%; or alcohol, 50% to 70%; submerging the lamps in the solution in a glass tumbler up to the brass lamp base. However, the following quotation of Mervini from "*The Textbook of Antiseptics*" by Dakin and Dunham (1917) shows a number of tests made to determine the time required to kill various organisms in alcohol of varying concentration. The inefficiency of certain strengths and lack of effect on certain organisms should be noted.

Dilution of Alcohol

	25%	50%	70%	80%	99%
<i>S. aureus</i>	12-24 hrs.	10 min.	10 min.	living after 3 days	
<i>B. pyocyanus</i>	under 1 hr.	10 min.	10 min.	6 hrs.	12 hrs.
<i>M. prodigiosus</i>	1 hr.	10 min.	10 min.	6 hrs.	12-24 hrs.
<i>B. coli</i>	24 hrs.	1 hr.	1 hr.	living after 24 hrs.	
<i>B. subtilis</i> (spores) . . .		All living after eight (8) days			
<i>B. anthracis</i> (spores).		All living after fifty (50) days			

An extra set of lamps should be kept immersed in antiseptic solution to insure a clean lamp always ready for immediate use.

CHAPTER VIII

TRANSILLUMINATION ESTABLISHED AS AN INDISPENSABLE AID

Careless observers have a tendency to believe that discolorations surrounding pulpless teeth might be due to root canal fillings or chemicals, but experienced diagnosticians, who have used transillumination on the

searchlight principle consistently, have long since proved the fallacy of this supposition.

All chemicals and fillings used in the treatment of teeth have been experimentally used in an exhaustive series of tests, and it is known to be impossible to create a shadow as the direct result of chemicals or fillings. To further aid in promoting this invaluable method of diagnosis and dispel this erroneous impression, the author offers a reward of One Hundred Dollars to the first dentist who can cause a shadow in the alveolar process (without infection) with any chemical or filling material used in treating root canals. This reward has been unclaimed for a number of years and it is now generally conceded that all opaque areas in the alveolar process during transillumination indicate infection. A sure and certain method of determining all blind abscesses is of inestimable value in both medical and dental diagnosis.

Considering the benefits to be secured by both the patient and diagnostician, every effort should be made to become efficient in diagnosis of all focal infections. Not only should diagnoses of the dental process be made, but the entire oral cavity, various air sinuses and the mastoid cells of those patients suffering sub-acute and chronic infectious conditions should be examined, and, if necessary, they should be referred for treatment.



PART TWO

CHAPTER I

THE VITALITESTER, WHAT IT DOES, AND HOW IT IS USED

Often, there is unnecessary conflict between medical and dental practitioners on the subject of dental diagnosis; the physician frequently condemning vital teeth for extraction on suspicion, because of fillings or crowns; and the dentist too often retaining infected teeth, because they show no area on the radiograph.

Testing of pulp life is necessary to dental diagnosticians, and is now being considered by careful medical practitioners who have learned that the vitality or non-vitality of pulps of teeth is of primary importance in the control of health. Many physicians are daily using the Dentalamp, the Vitalitester and explorer, finding that the diagnoses, so obtained, are more dependable than can be had by referring their patients to dentists who are not similarly equipped and who have frequently failed to find the full extent of infection.

Too much dependence has been placed on radiographic diagnosis of teeth by both physicians and dentists, and errors are of common occurrence. It is with the hope, then, that vital teeth may be saved and infected teeth may all be found, that I offer this chapter on the Vitalitester.

Too few dentists are aware of the fact that teeth with non-vital pulps showing no area on the x-ray film are just as dangerous as those indicating pronounced infection. The following tabulations made at the Deaner Institute prove this:

RESULTS OF QUANTITATIVE TOOTH CULTURES.

Group	Number Cultured	Number Showing 10 or More Colonies in Deep Agar Tube.
Vital Teeth	377	4%
Pulpless Teeth with Negative Radiograph	408	43%
Pulpless Teeth with Positive Radiograph	339	59%
All Pulpless Teeth	747	50%
TOTAL	1124	

The method followed at the Deaner clinic is to make a control culture at the time of the extraction, and excise the infected tooth root into a

culture tube. After incubation of the cultures, rabbits are injected, and the results confirm the findings of medical and dental authorities. The controls prove less than five per cent error in laboratory tests.

An analysis of the findings of leaders in the field of pathological research gives evidence that every non-vital tooth is considered a menace to the patient's health, and that such teeth showing a large area are less dangerous than those with which the radiograph indicates negative or only slight change.

The incidence of non-vital teeth is shown by the following graph from the Deaner Institute:

INCIDENCE OF PULPLESS TEETH.

Number of Patients.....	500 (7,000 Films)
Patients with Pulpless Teeth.....	91%
Patients with Apical Rarefaction.....	68%
Average Number Pulpless Teeth Per Mouth.....	3.9
Average Number Rarefied Areas Per Mouth.....	1.5
Average Number Missing Teeth Per Mouth.....	6.4

There being well-recognized limitations to both transillumination and radiography, it is well to consider the use of the Vitalitester as a routine necessity in dental diagnosis, because it can be seen that the question of pulp vitality is a most important factor, and very frequently this instrument gives convincing confirmatory evidence of prior findings.

One has only to consider the common methods in dental diagnosis, such as palpation, percussion, thermal, exploratory tests, and the x-ray, to be fully convinced of the necessity of supplementing these long-used and woefully inefficient aids. Macroscopic examination of a tooth is necessary; but a diagnostician would hesitate to pass on the condition of the pulp or the vitality or non-vitality of a tooth by its appearance. It is well known that the pulps of many vital teeth have been opened up with a drill because of lack of knowledge of pulp conditions—a fatal error.

While it is possible in the majority of cases to ascertain the vitality or non-vitality of pulps, one has also to consider the advantage of a positive and scientific method of determining the effect of devital teeth on the pulp life of proximating vital teeth. There is a gradual progression of pathologic evolution that is of great importance to careful diagnosticians, and it is easily proven that pulpless teeth frequently cause complete loss of vitality of approximating teeth. This condition the Vitalitester will show, because of the variation in current necessary to produce the reflex.

Dependability of results secured and the safety of the patient should be a primary consideration in the use of any equipment. The value of the electric test for pulp vitality has never been disputed; but unsatis-

factory equipment provided for this purpose in the past has greatly hindered the general acceptance of this vital aid to dental diagnosis. Now, however, with the perfection of the Vitalitester, the entirely new and original principles followed in its construction have eliminated the dangers and inefficiencies of the older types of pulp testers.

When first investigating the various types of equipment offered for this purpose, their weaknesses became apparent. The current was usually induced and transmitted from the hand electrode throughout the body to the tooth under examination. This sometimes caused a severe shock and, in many instances, actual danger to the patient.

The faradic or galvanic (dry cell current) method lacks uniformity of results, because of the deterioration of the dry cells. The violet-ray machine has also been tried, but it has pronounced limitations, because of the arcing of the current to metal fillings and crowns. Then, too, the effect on the nervous patient of the high current induced by the Tesla coil used in this type of machine must be considered. Very few patients present themselves in the dentist's office in a mood of mind where they are willing to be struck by lightning, and most frequently this is the thought that such equipment creates.

A type of instrument sometimes used is the ordinary rheostat on city current with hand and tooth electrodes. With this, there is actual danger of severe shock to both patient and operator due to a grounded line. Many dentists have discarded this type of equipment because of the dangers experienced from its use. In many of the types mentioned, the comparatively high amperage has not infrequently caused a severe recurrent toothache, and the pulp thereby became devital. Undoubtedly, many of the non-carious and unfilled teeth found with devitalized pulps are the result of the use of such unscientifically constructed equipment.

It is well established that in different individuals there is a variation from 15,000 to 50,000 ohms in body resistance. One patient will respond to one-third the amount of current required for another patient. So instruments with hand or cheek electrodes had to be constructed to overcome the maximum body resistance to induce a sensation, which occasioned too great a shock to sensitive patients.

Diffusion of the current throughout the body by these methods and the uncertainty of results, because of the conductivity of metal fillings, metal crowns and the saliva to sensitive areas, were factors that caused the majority of the users of such equipment to discard them as wholly inadequate for scientific determination.

The first important step in the development of the Vitalitester was to induce the shock only in the field of examination, so there could be no confusion from a positive or negative finding.

Entirely new electrical principles are followed in the construction, and a special winding similar to an x-ray coil is used. This coil contains more than three-quarters of a mile of wire. The current is mildly graduated from one to twelve, as shown on the scale in Figure 44, and at the high point is sufficient to induce a response even if the vitality is greatly deficient as compared to normal.

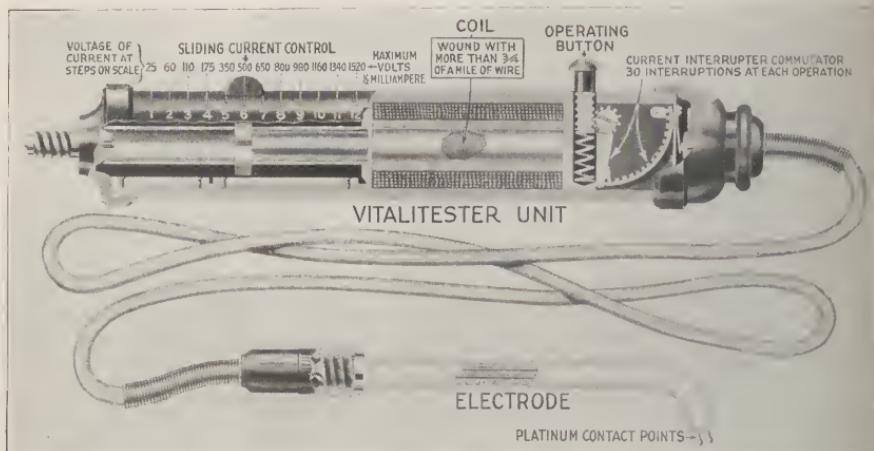


FIGURE 44
Diagrammatic cross-section of the Vitalitester.

The Vitalitester is assembled as illustrated in the chart, Figure 45, the Coronal Electrode being used for ordinary conditions and the Gingival Electrode used for testing crowned teeth at the cervical margin. This instrument will operate from either alternating or direct current, but must always be used with the Dentalamp Vitrohm Potential Adjuster which connects with an electric light socket.

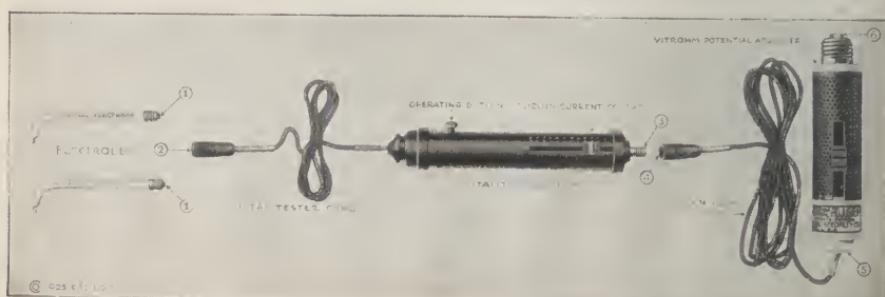


FIGURE 45
Chart of assembly of the Vitalitester for testing pulp vitality.



FIGURE 46
Method of contacting Coronal Electrode on occlusal surface of tooth under test.

The error of methods with which body resistance is taken into consideration being apparent, the Vitalitester was designed for application of both electrode terminals in direct contact with the tooth under examination, the current being diffused and felt only at the actual point of contact, as shown in Figure 46. The electrode terminals are made of platinum and conveniently spaced for application to teeth of either adults or children.

When using the Vitalitester, it is only necessary to contact the two platinum points

of the electrode to the most convenient surface of the tooth under examination. Figure 47 shows the Vitalitester in use. The sliding current control should always be at the lowest step (1) for the first test (on every tooth), and the operating button slowly depressed. If no reflex is obtained, the button is operated forcefully, increasing the rapidity of the make and break of the current. If no response is obtained, the sliding button is advanced one step or more at the discretion of the operator, until a mild sensation is felt. The electrodes should be applied on the various surfaces of the tooth, and it is frequently possible to obtain a response with less current in the sulci.

The current only flows between the two contact points of the electrode and never jumps to adjacent vital teeth, even where there are metal crowns and fillings. It has been conclusively proven by thousands of tests that the current never radiates through the tooth structure into the peridental membrane or gum tissue—a source of error frequently reported with the use of ordinary pulp testers. See Figure 48.

The Gingival Electrode is used to test teeth with gold crowns because it is usually possible to retract the gum tissue at the neck of the tooth sufficiently to contact the points of this Electrode; illustrated in Figures 49 and 53. Care, of course, must



FIGURE 47
Method of using the Vitalitester in testing the teeth of patients.

be taken that the platinum points do not touch the crown or gum tissue. No shock will be felt if both points of the electrode are placed on the metal—even on vital crowned teeth, or vital bridge abutments, for in these cases the current will take the shortest unimpeded path between the poles without being conducted to the tooth. However, tests may be made if one contact is made on metal fillings or crowns and the other contact is made with any portion of the natural tooth structure. It is usually possible to test teeth through porcelain jacket crowns.

The teeth should never be dried off for making the test. The normal moisture of the mouth is best adapted for ready response, but saliva will not conduct the current into the gum tissue. This can be readily demonstrated by setting the Vitalitester at six, pressing the contact points against the ball of the thumb, and depressing the operating button. A mild sensation will be felt. Then by placing a full drop of water over the same spot and retaining it there, applying the electrode with current set at twelve, there will be no response, proving that an excess of moisture will not conduct the current to the process.

The graduation of current in twelve successive steps, as indicated on the Vitalitester scale, ranging from 25 volts to 1520 volts, with less than one-half of a milliampere, is amply sufficient for the determination of pulp vitality of any tooth. At step one on the Vitalitester scale, the current is so mild that it may be applied to the moist mucous surface of the lip without inducing shock, producing only a slight tingling sensation.

The voltage is regulated by the sliding current control, as well as by the speed with which the operating button is depressed. Slow manipulation results in a milder sensation, than when the operating button is depressed and released rapidly. No current flows until the button is operated.



FIGURE 49

Showing use of Gingival Electrode at cervix on tooth with gold crown.

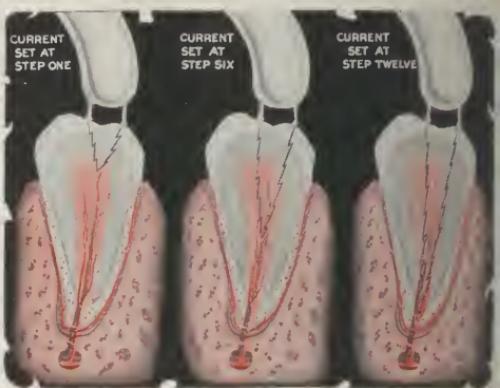


FIGURE 48

Illustrating the path of the current through tooth—Vitalitester set at steps one, six and twelve.

Normal teeth do not all respond to the same amount of current. This varies more or less with each individual. The incisal surface of most anterior teeth will usually give a response at point one, depending on the degree of abrasion or pulp recession. Canines usually require a greatly increased current flow, because of the difference in tooth structure and thickness of the enamel.

Accurate and scientific determinations are made by comparison of the amount of current required on corresponding opposite teeth on the same individual. A variation of as much as two steps on the Vitalitester scale can usually be considered an indication of changing vitality. For instance, in testing a first molar, the response might be secured at point one; and on other patients, current at point four or five, or even higher, might be necessary. However, should the lower right first molar respond at point one and a greatly increased current be required for the lower left first molar of the same patient, this would be considered evidence of pathologic change.

Pyorrhreal teeth can be tested very accurately with the Vitalitester. A careful record of each tooth should be made when beginning the treatment, and a relative comparison of the current required when the work is completed will serve as an index to the completeness of the recovery. This scientific method of recording pulp restoration is well illustrated in injuries from a blow. Sometimes where the trauma is so severe that there is temporary paralysis, little or no response can be obtained even at the highest step. When these areas show evidence of repair, the result is indicated by the lesser current required to produce a response. It has been proven that the extraction of a pulpless tooth frequently means the restoration of approximating teeth to normal vitality. The value of these determinations, never heretofore possible, is readily apparent. See Figures 50, 51 and 52.

Probably a most important feature in the use of this equipment is not alone the determination of the vitality or non-vitality of the pulp of any certain tooth; but that the careful operator can make a complete electrical chart of the mouth of any patient in a few minutes. Attention can usually be thereby directed to the change of vitality on teeth proximating a devital tooth, this being evidenced by the increase of current necessary to produce a reflex as compared to the corresponding opposite normal tooth. In this way the patients can frequently be impressed with the seriousness of the existing



FIGURE 50
Transillumination shows pronounced congestion at second bicuspid with evident involvement of the alveoli of proximating first molar and first bicuspid teeth.
See Figures 51 and 52.

conditions, and induced to report for reparative treatment before complete devitalization of approximating teeth takes place.

In modern dentistry a very important factor in successful practice is the control of the patient, for it is well understood that success to a large degree is dependent on early treatment of the various infections. Any tooth showing a pronounced lowering of pulp life, as indicated by the increased current necessary to produce a reflex, would be of interest to the dentist and would sufficiently impress the patient with the advantages of frequent careful examination.

The safety of the Vitalitester can be instantly determined by adjusting the current control to twelve on the scale and contacting both electrode points with a grounded line, such as a water pipe or radiator. Scarcely a spark is noticeable, even with the high current induced—a test of the equipment which proves that there is no danger to the patient whether grounded or not, a feature of safety not heretofore obtained. This instrument, connected and assembled as shown in Figure 45, may be used under any condition with the full assurance that no harm can come to either patient or operator.

The absence of noise, spark, sputter and severe shock makes it easy to handle nervous patients. No elaborate technique is necessary in its use. It is extremely satisfying to know that any operator can thoroughly familiarize himself in fifteen minutes with the use and technique of the Vitalitester to operate it with perfect ease, safety and assurance.



FIGURE 52

A sufficient period after extraction of second bicuspid, transillumination shows return to normal in entire area, and the vitalitest indicates restoration of normal pulp vitality in first molar and first bicuspid as compared to corresponding opposite teeth. See Figures 50 and 51.



FIGURE 51

The Vitalitester proves complete loss of pulp vitality in second bicuspid; while first molar responds at step 9 and first bicuspid at step 8, compared to 6 and 5 respectively for corresponding opposite normal teeth. See Figures 50 and 52.

Doubt often exists as to the number of teeth involved in an area of infection, especially where fistulæ or scar tissue are present. The Vitalitester will indicate the non-vital teeth in these areas, and is frequently the means of saving vital teeth that might otherwise be extracted. This instrument is also of great service in the testing of deciduous teeth and six-year molars when erupting, for even the most careful x-ray diagnosis is frequently indefinite because of the partly-formed and unerupted teeth.

The frequent proving of the non-vitality of the pulp of a non-carious unfilled tooth



FIGURE 53
Determination as to whether the congestion shown by transillumination is due to apical infection or not with the aid of the Vitalitester.

in situ, approximating an edentulous area, is of great interest.

Occasionally, transillumination may reveal congested areas, and yet the infections may not be apical; but due to gingivitis, pyorrhea, or to trauma from impingement of crowns or fillings. The vitality of such teeth being proven, it is advisable to consider treatment of these cases. Checking transillumination findings with the Vitalitester is illustrated in Figure 53.

It might be well at this point to emphasize the limitations of the electric test. A multi-rooted tooth with vitality in one root will give a response requiring much more current than normal, of course. In these cases, any positive evidence of infection must be accepted, and this possibility should always be considered with multi-rooted teeth.

It may be safely assumed, however, that any tooth with any degree of pulp vitality will respond, and the failure to obtain a response at step twelve would indicate complete devitalization.

One must also take into consideration, with elderly patients, the deeply abraded surfaces of anterior teeth with complete pulp recession. Such cases have presented themselves where the gum tissue was in good condition, no pyorrhea, no history of any trouble, no shadows under transillumination, but with evidence on a radiograph of complete recession of the pulps. These teeth do not respond to the vitalitester; but the condition is obvious to the average diagnostician.

Use and experience with this method will prove many additional advantages not heretofore noted. Interesting evidence of this is shown by an article recently received from Dr. Leo Stern of the Department of Oral Surgery, Columbia University:

"The use of a carefully controlled and graduated electric current to determine the physiologic status of the dental nerve-trunks is comparatively new. Its field of application, however, is varied and extensive, and through the medium of the Vitalitester its accomplishment is quite simple.

An excellent example of its usefulness may be found in estimating the progress of repair after nerve-trunk traumatization incidental to oral surgery. But, it also occupies an indispensable position in daily usage as a means of determining the profundity of local anesthesia.

In the past it has been considered good practise to test the anesthetic effect of a conduction injection by inserting a sharp instrument into the oral mucosa at a point that should be included in the

anesthetic zone, depending on the patient's reaction to ascertain the effectiveness of the injection. This method possesses obvious disadvantages: it necessitates needless traumatization of the mucosa; and it is inaccurate because its efficacy depends on the patient's interpretation of sensory reaction. Moreover, it is strictly arbitrary, inasmuch as it affords no information regarding the degree of anesthesia.

I have found that reaction to electrical stimulation on the part of the dental pulp offers a dependable and practicable means of testing the extent and degree of dental anesthesia. The technique employed is as follows:

Several minutes after the deep procain injection has been made, any obviously healthy tooth not included in the zone of anesthesia is selected and the index of its pulp-response ascertained. This index is used as a guide. One of the teeth, which must be included in the zone of anesthesia, is then tested. Following a right-sided mandibular injection for example, the left mandibular cuspid, which responds perhaps to a current index of 3, may be used as a guide. The right cuspid is tested and responds only after the electrical resistance has been advanced to step 6. Other factors being equal, this demonstrates that anesthesia is becoming effective. Usually, within another minute a distinct advance in the response index will be observed, until after the expiration of from five to twenty minutes the extreme of current available (current index 12) fails to evoke response. When this condition obtains, anesthesia will be found to be of a complete character.

This technique is fundamentally correct and accurate, is not time consuming nor difficult, and its applicability is almost universal."

One of the most interesting phases of this work has been the finding of many root-canal treated teeth which respond to the Vitalitester. Many



FIGURE 54

Radiograph of teeth treated by the Vitalotomy Technique, and which respond to the Vitalitester owing to partial pulp vitality.

of these teeth had been filled for five or ten years without history of any trouble. No shadow was evident in transillumination, and a radiograph did not reveal any apical change. These teeth respond to the current at 8 to 12. Usually, the radiograph in these instances would reveal a partially filled root canal as shown in Figure 54, a fair assumption being that the technique, as described by Dr. Clyde Davis in his "*Operative Dentistry*," Fourth Edition—Chapter 35, was intentionally or inadvertently followed.

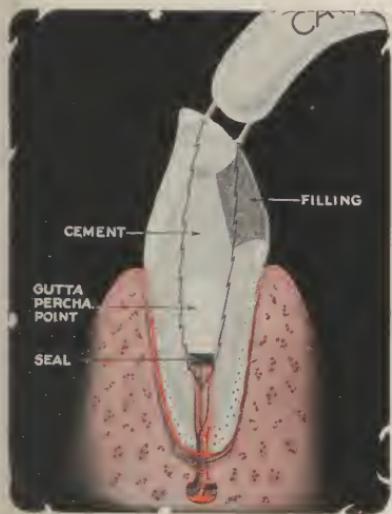


FIGURE 55

Cross-section of a tooth illustrating treatment by the Vitalotomy Technique.

In using this technique it will be readily apparent that the Vitalitester is of splendid service, because it demonstrates the condition of pulp vitality before, during and after the operation, and it would appear from the results obtained by Dr. Davis that this technique is worthy of careful consideration, because it seems to have pronounced advantages as compared to the attempted complete extirpation of the pulp. Figure 55 illustrates a cross-section of a tooth so treated. This instrument being of such value in this work, dental surgeons have suggested the name "Vitalotomy Technique" for this operation.

The careful diagnostician is fully cognizant of the necessity of piling

"proof on proof" in diagnosis, and this instrument has a peculiar field of usefulness in furnishing confirmatory evidence to findings by transillumination and radiography. Summarizing, when in doubt as to the cause and effect of infected areas in the alveolar process, use the Vitalitester.

Transillumination and the vitalitester will be of special interest to those who do not have an x-ray machine readily available, and their value is fully appreciated by those operators who feel that their radiographic diagnosis is not one hundred per cent correct. These two methods eliminate the necessity of repeated x-ray diagnoses, avoiding a loss of time and the possibility of dangerous x-ray burns.

CHAPTER II

A SUMMARY OF TRANSILLUMINATION AND THE VITALITEST FOR ROUTINE PROCEDURE

Transillumination should be the first step in all dental diagnoses, and it should be remembered that the Dentalamp is of value in every field of dentistry.

DIAGNOSIS BY TRANSILLUMINATION

1. Transilluminate the entire alveolar process from buccal and lingual surfaces with the Right-Angle Dentalamp, using light of varying degrees of intensity. All healthy process is clear and trans-

lucent. A variation from the normal healthy translucency always means congestion.

2. Alveolar process about pulpless teeth, with or without root canal fillings, will never show discoloration, unless congestion is present. Shadows are never due to chemicals or fillings, but are always a certain index to the presence of periodontal destruction, blind abscesses, cysts, granulomata, etc.

3. Examine the alveolar process for pyorrhæal stræ, pus pockets, serumal deposits, salivary calculi, etc. These conditions are plainly indicated by the Right-Angle Dentalamp, and may be easily shown to the patient by the use of a hand mirror and scaler.

4. Use the Straight Dentalamp with mirror attached, and make a careful inspection of the teeth to determine the number of cavities and the spaces for lodgment of food and foreign substances, the number of teeth missing, and the occlusion. In examining abscessed teeth, note carefully if there are fistulæ or scars on the alveolar process, or if pus is draining at the gum margin or through the pulp chamber.

5. Make a survey of the tonsils and the mucous membrane of the mouth with the Straight Dentalamp and mirror.

6. If the upper cuspids or molars are found to be infected, transilluminate the maxillary sinuses, for these teeth are a frequent cause of antral infection.

7. Cases reporting acute recurrent neuralgic pains should be examined with the Straight Dentalamp in the dark-room for frontal sinus involvement, and with the Antralamp for mastoid infection.

8. The following morbid conditions may not be indicated by shadows: acute pulpitis with no pathologic change outside the tooth structure, acute inflammation accompanied by a swelling of the cheek or jaw, impacted molars, malformations and fractures, and those cases where there is a fistula or history of drainage, or where there is bone destruction without present congestion.

DIAGNOSIS WITH THE VITALITESTER

9. The vitality or non-vitality of the pulp of any tooth can be immediately determined with the Vitalitester.

10. It is obviously impossible to transmit a message of pain to the brain from a pulpless tooth when the "wires" are down and out, and no reflex is obtained from the dissipation of the current into the periodontal membrane or gum tissue.

11. The current always takes the shortest unimpeded path between the two poles or electrode points, and no shock is felt from contact

with metal crowns or fillings, or bridge abutments on proximating vital teeth or gum tissue.

12. Crowned or filled teeth may be tested with one contact point on the metal and the other on the natural tooth structure.

13. The current induced at step one on the Vitalitester scale is so mild that it may be applied to the moist mucous surface of the lip of a nervous patient, or to deciduous teeth of children without shock. Operate the button slowly for a mild sensation with the index set at one on the Vitalitester scale, and speedily for a maximum reflex at this point. Advance the current one step at a time in doubtful cases until a sufficient response is obtained. The current induced at twelve is amply sufficient to demonstrate the vitality or non-vitality of the pulp of any tooth.

14. The Vitalitester should be connected as shown in Figure 45, and is safe to use under every condition. There is no noise or spark, and the current is induced only between the platinum points of the electrode.

15. Because the current is not sent through the patient's body from hand or cheek electrodes, the reflex is obtained with a minimum of current, and there is no possibility of injuring the patient because of variation in body resistance.

16. No current passes through the instrument until the button is depressed, and one complete operation makes and breaks the current thirty times.

17. The value of the instrument in the Vitalotomy Technique is readily apparent, for the condition of the pulp is indicated before, during and after the operation.

18. It is not only possible to demonstrate the vitality or non-vitality of any certain tooth, but scientifically record the progression of pathologic evolution in pulp conditions by repeated tests over any period of time; the change being indicated by the variation in current flow necessary to produce the reflex.

19. The instrument provides a ready means of determining the condition of the pulps of doubtful teeth approximating infected areas.

20. The Vitalitester will give you positive or confirmatory evidence in practically every doubtful diagnosis of pulp vitality.

Briefly stated:

Radiography will be of value in the diagnosis of an infected tooth, if there is pronounced change in the bony structures—but it must be remembered that an x-ray film is nothing more than a photographic record of relative density;

Transillumination will reveal congestion of the periodontal membrane and tissue around the root of the tooth, and show immediately the entire area of infection;

The Vitalitest will indicate scientifically and accurately the condition of the pulp of the tooth.

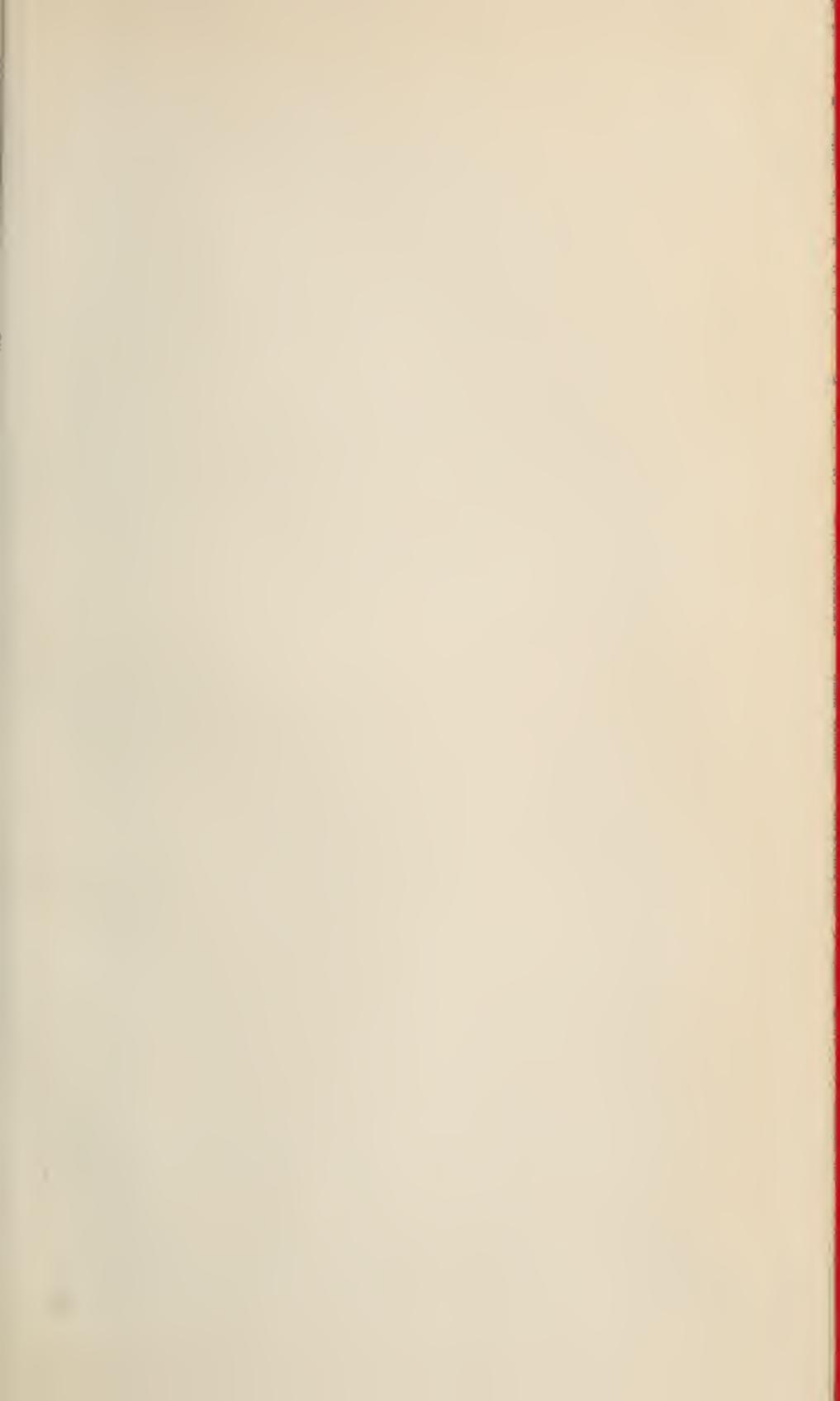
The popular acceptation of transillumination and the vitalitest in modern diagnosis, due to the certainty of determinations, has firmly established them in routine procedure. Knowing the excellent results that are possible, it is not surprising that the majority of physicians and dentists use, and attest the positive advantages of these necessary aids, and no one with knowledge and experience has disputed their value. The full enthusiasm created by the intelligent application of these newer methods can only be understood and appreciated by continued use in daily practice.

In conclusion, it is well to remember the familiar quotation:

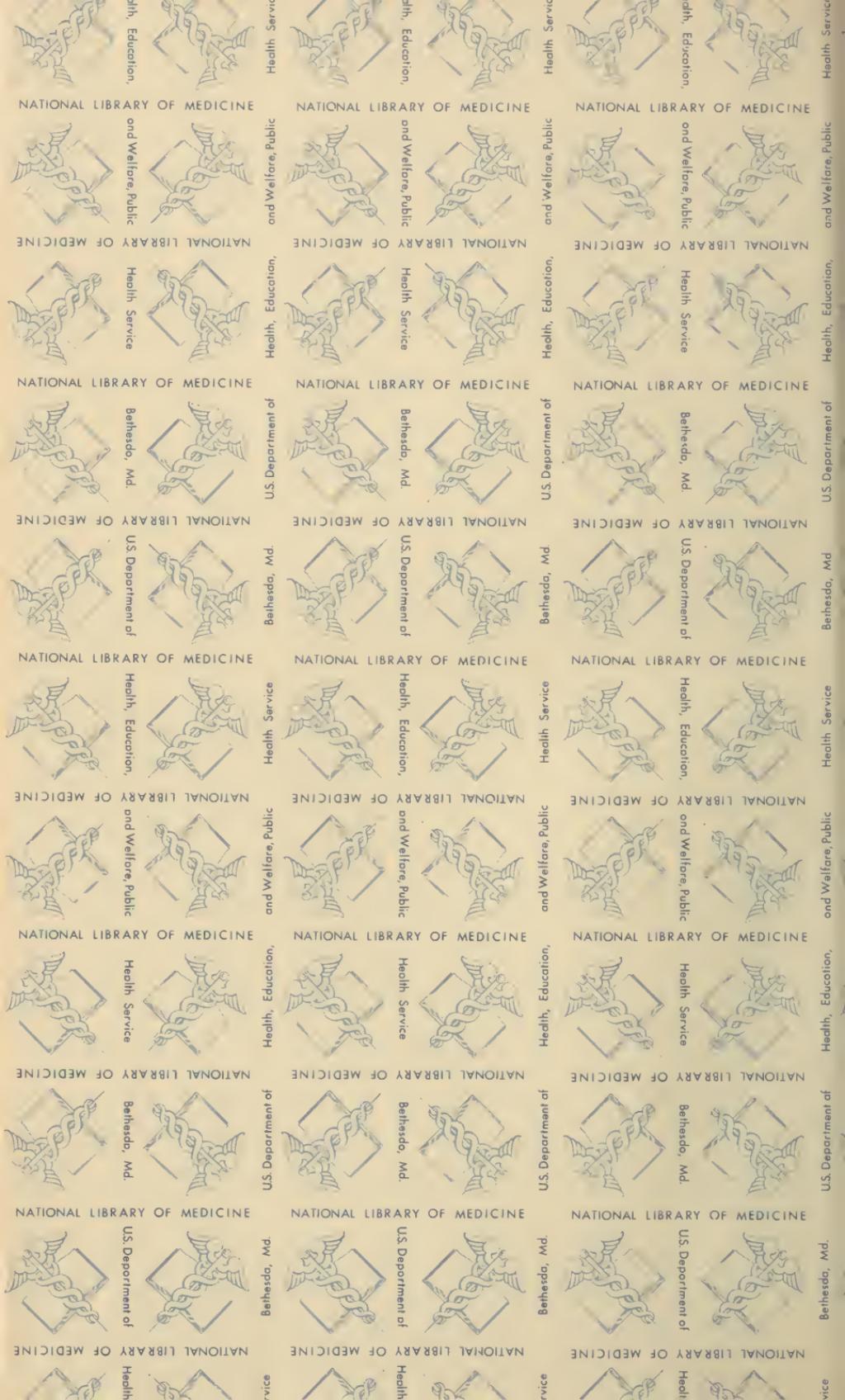
“Be not the first by whom the new are tried,
Nor yet the last to lay the old aside.”

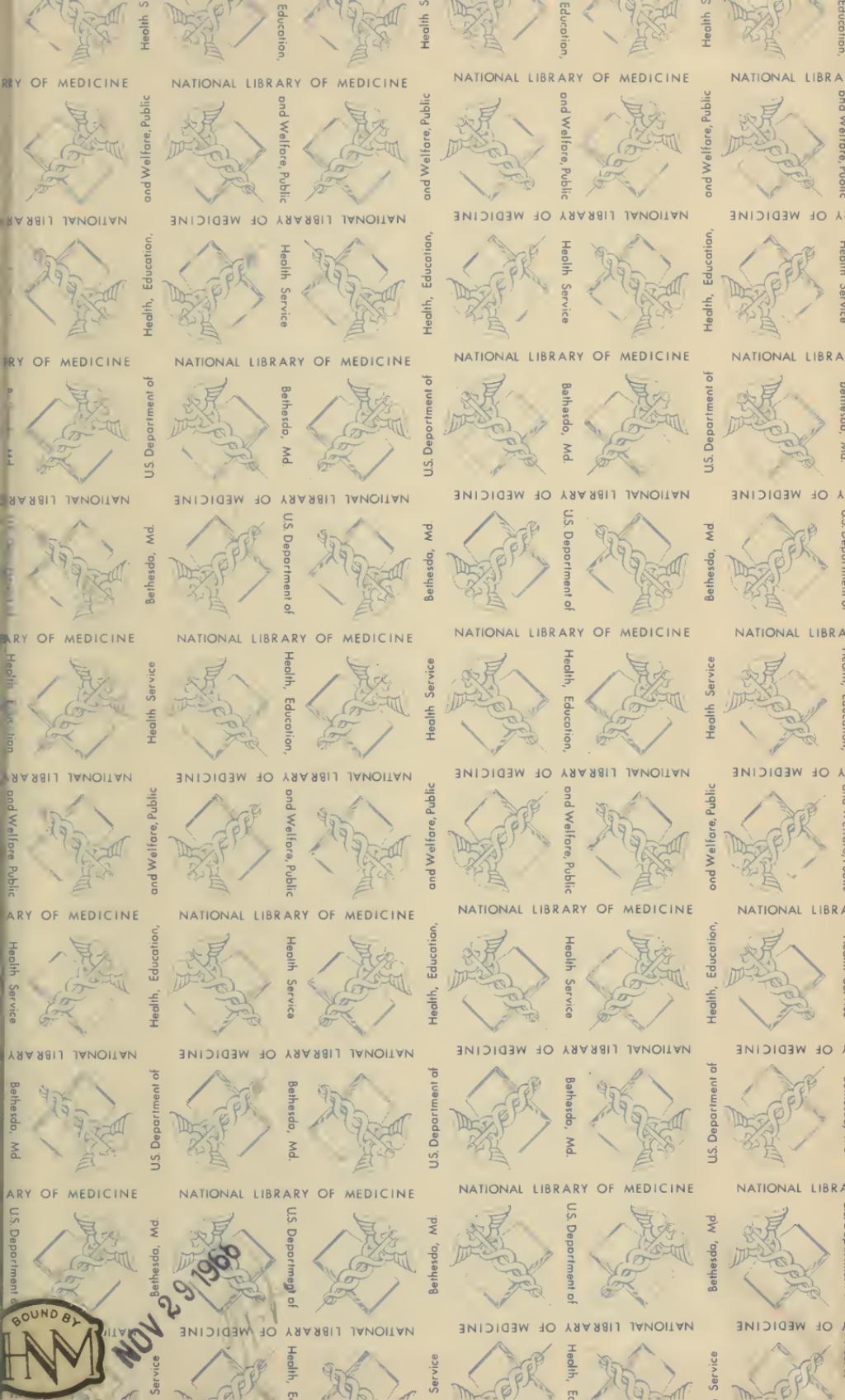
—*Alexander Pope.*











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